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NOTES ON FISHES FROM AUSTRALIA AND LORD HOWE ISLAND.

By

ALLAN R. MCCULLOCH, Zoologist, Australian Museum.

(Plates i-iii.)

The Trustees of the Australian Museum have received a large and interesting collection of fishes from Mr. E. H. Rainford, collected by him in the neighbourhood of Bowen, Queensland. This includes many species not previously recognised from Australian waters and some which are regarded as new. Another equally interesting collection has been made by Mr. R. E. Baxter, of Lord Howe Island, and presented by him to the Australian Museum. A few species from each of these collections are dealt with in the following paper.

FISHES FROM AUSTRALIA.

Family CHAETODONTIDAE.

Genus CHAETODON *Linnaeus.*

The following key to the Australian species of this genus is based upon examination of numerous specimens in the Australian Museum collections. Every endeavour to utilise the sub-genera of Bleeker's "Atlas Ichthyologique" and Jordan & Seale's "Fishes of Samoa" has failed, and it seems that each includes little more than its typical species.

a. Some or all of the scale-rows below the lateral line run obliquely upward and backward.

b. Scale-rows oblique as above on both upper and lower parts of sides.

c. Profile convex, not concave, at base of snout, which is obtuse.

d. An oblique line on each row of scales on the sides; a broad black band before the ocular band covering the snout, and a narrow one behind it. Dorsal, anal, and caudal, each with a black stripe with light-coloured margins. *trifasciatus.*

cc. Profile concave at base of snout, which is more or less produced.

e. Scale-rows of upper anterior part of sides with dark lines running upward and backward and at *right angles* to those running downward and backward on lower posterior portion. (Subg. *Linophora auriga*)

f. Dorsal with a produced setiform ray and a black ocellus. *setifer.*

ff. Dorsal without a produced ray; a dark band from the dorsal across the peduncle to the anal. *vagabundus.*

ee. Scale-rows either without dark lines, or, if they are present, they do not meet at right-angles.

g. Ocular band mesially yellow with dark edges.

h. Body with seven oblique dark stripes running upward and backward; a dark cross-bar on caudal; ventrals pale. *pelewensis.*

gg. Ocular band black.

i. Ventrals blackish, body dark-coloured. ***flavirostris.***

ii. Ventrals and body light coloured with dark markings.

j. Ocular band much narrower than eye.

k. Each scale-row with an oblique dark line running upward and backward; and other markings. ***melanotus.***

jj. Ocular band as broad as, or broader than, eye.

l. Body with subvertical dark lines descending through each scale-row; scales very large and somewhat angular.

m. Two broad dark bands descending from dorsal fin onto upper half of sides, and a large black spot on peduncle. ***falcula.***

mm. A broad black band around base of dorsal, crossing the peduncle to posterior base of the anal. ***lineolatus.***

ll. No dark subvertical lines through scale-rows.

n. A broad black bar extending obliquely upward from shoulder to middle of spinous dorsal, and other markings. ***lunula.***

bb. Scale-rows oblique on upper anterior part of side but more or less horizontal on lower portion.

o. Each scale with a round black spot forming oblique rows above and horizontal ones below. Anal broadly black-edged, the other fins plain. ***citrinellus.***

oo. Four subvertical dark lines from back onto sides; a dark infra-marginal border on the dorsal and anal fins, and a black ocellus on the former. ***assarius.***

aa. Scale-rows either horizontal or running somewhat downward and backward.

p. Scales large in 35 or less series.

q. One or two produced setiform dorsal rays. Snout beak-like. Scales of sides not remarkably large. (Subg. *Rhabdophorus ephippium*).

r. A large black patch covering greater part of second dorsal and part of back. *ephippium.*

qq. No produced dorsal rays; snout not beak-like. Scales on middle of sides very large, the rows running downward and backward.

s. A broad dark band from spinous dorsal to ventral and a much broader one from soft dorsal to anal. ***kleinii.***

pp. Scales small, in 40 or more series.

t. Ocular band as broad as eye, black.

u. Two broad black vertical bands crossing body and vertical fins. ***tricinctus***—L. Howe Id.

tt. Ocular band much narrower than eye.

v. Body and fins with seven narrow equidistant dark cross-bars. Ocular band dark. ***octofasciatus.***

vv. Body either plain or with three broad cross-bands; ocular band yellow with dark edges.

w. Three broad cross-bands descending from the dorsal fin, which are lilac-coloured in the middle portion, with orange borders. ***rainfordi.***

ww. Body largely brown, without cross-bands descending from the dorsal fin. ***aureofasciatus.***

CHAETODON SETIFER *Forskal.*

Chaetodon setifer Bloch, Ichth. xii, 1797, pl. ccccxxvi, fig. 1. *Id.*, Günther, Fische Südsee i, 1873, p. 36, pl. xxvi, fig. 13.
Tetragonoptrus, Linophora, auriga Bleeker, Atlas Ichth. ix, p. 47, 1878, pl. ccclxxiii, fig. 4 (not *C. auriga* Forskal).
Chaetodon auriga var. *setifer* Day, Fish. India, 1875, p. 106, pl. xxvii, fig. 3.

A fine specimen, 170 mm. long, is in the Australian Museum from the Clarence River estuary, New South Wales, and two others from Holbourne Island, off Port Denison, Queensland, which were collected by E. H. Rainford.

CHAETODON VAGABUNDUS *Linnaeus.*

(Plate i, figs. 1-2).

Tetragonoptrus, Linophora, vagabundus (Linn.) Bleeker, Atlas. Ichth. ix, 1878, p. 48, pl. ccclxxviii.

Variation.—A series of fifteen young specimens, 24-54 mm. long, exhibits an interesting range of variation in the ornamentation of the dorsal fin. In the youngest specimens, one of which is figured (Pl. i, fig. 2), the soft dorsal fin bears a large black ocellus, and a dusky stripe crosses the rays about the middle of their length; a similar stripe is present on the anal. The ascending lines of the sides are distinct, but the descending ones are not developed. The dorsal spines are much higher than the rays in the young fish and the head is encased in a thick bony armature. With the growth of the fin-rays the dorsal ocellus is gradually moved towards the margin of the fin, where it is eventually lost, and the stripes on the anal and dorsal fins approach the margin to form the black borders which are characteristic of the adult fish. Pl. i, fig. 1 represents a specimen 54 mm. long, in which the ocellus, though distinct, is moving outwards and is confused with the black border.

Localities.—Many specimens are in the Australian Museum from the Solomon Group, New Hebrides, Fiji, Duke of York Island, and Papua. Two young examples which I collected at Murray Island, Torres Strait, and another from Cairns Reef, off Cooktown, Queensland, are the first of the species to be recognised from Australian waters.

CHAETODON MELANOTUS *Bloch & Schneider.*

Tetragonoptrus, Chaetodontops, melanotus (Bloch & Schneider) Bleeker, Atlas Ichth. ix, 1878, p. 43, pl. ccclxxvi, fig. 1.

Two large examples which I collected at Murray Island, Torres Strait, are the first of the species to be recognised from Australian waters. Others are from Port Moresby, Duke of York Island, Admiralty Islands, and the Solomon Group.

Chaetodon lineolatus *Cuvier & Valenciennes.*

Chaetodon lineolatus (Cuv. & Val.) Günther, Fische Südsee i, 1874, p. 45, pl. xxxiv, fig. A.

Tetragonoptrus, Oxychaetodon, lineolatus Bleeker, Atlas Ichth. ix, 1878, p. 51, pl. ccclxxvii, fig. 2.

Colours.—Body silvery grey, darker above, and ruled with black lines down the scale rows. A broad black stripe from the nape through the eye to the throat and joined by its fellow across the forehead by a horizontal stripe above the eyes. Another broad black stripe from the middle of the dorsal, across the caudal peduncle to the base of the anal, which is bordered anteriorly by a bright golden area. Dorsal fin golden, the soft portion with a light, dark-edged stripe across the middle of the rays. Anal golden. Caudal gold with a dark-edged submarginal stripe and a narrow white border.

Two fine specimens were collected by Mr. Rainford near Whitsunday Island, Queensland. This species has not been previously recognised from Australian waters.

Chaetodon lunula *Lacépède.*

Chaetodon lunula (Lacépède) Günther, Fische Südsee i, 1874, p. 42, pl. xxxiii.

A fine series of fourteen specimens, 26-192 mm. long, exhibits the three stages illustrated by Günther in "Fische der Südsee," pl. xxxiii, figs. A, C, and D. Of these, eleven are from the New Hebrides, one from Amboyna, and one from Two Isles, off Cape Bedford, North Queensland. The species has been recognised from Australian waters by Cuvier and Valenciennes, who identified a drawing in the Banksian Library of a specimen captured at Prince of Wales Island, Torres Strait.

Chaetodon rainfordi *sp. nov.*

(Plate ii, fig. 1.)

D.xi/21; A.iii/18; V.i/5; P.14; C.17. About 45 rows of scales between the origin of the lateral line and the hypural joint.

General form sub-circular, the depth from the tips of the erect dorsal spines to those of the anal greater than the length to the hypural joint. Anterior profile very slightly convex, but concave above the snout, which is a little prominent. Scales rounded, largest on the anterior portions of the sides and becoming much smaller posteriorly; they are arranged in subhorizontal rows between the lateral line and the abdomen, but follow the curvature of the line above it. Lateral line terminating about the base of the eighteenth dorsal ray.

Margin of dorsal fin rounded, the median spines a little longer than the posterior ones; the base of the spinous portion is of the same length as that of the soft part. Anal rounded, the third spine longest. Ventral spine large, reaching the vent, the first ray filamentous and reaching the second anal spine. Caudal truncate.

Colours.—Canary yellow, with darker orange cross-bands. A narrow dark-edged stripe with light lavender borders extends down the median line of the forehead to the upper lip. The ocular band, which is much narrower than the eye, commences on the nape and passes through the eye and across the cheek to the breast: it is deep orange with narrow blackish edges, and has a light lavender border on each side, which is broadest below. A narrow orange band curves forward from the third dorsal spine to the end of the operculum and then backward over the base of the pectoral to behind the ventral; its anterior edge is partly defined by a blackish line, and it is preceded by a broad lavender stripe from above the operculum to the axil of the ventral fin. A broad composite band curves forward from the 6th-9th dorsal spines to the region of the vent; its middle portion is deep lilac, which colour is darkest above, and bordered with rich orange on each side; most of the scales bear dark basal spots, which tend to form dark edges to the orange borders. Another similar band descends from the anterior part of the soft dorsal to that of the anal. A less defined orange band crosses from the posterior part of the soft dorsal to the anal and encloses a large rounded spot on the caudal peduncle. All the fins are uniformly bright yellow, but the caudal has a broad pale lavender border.

Described and figured from a specimen 118 mm. long from Holbourne Island, registered I.A.273.

This species is named after its collector, Mr. E. H. Rainford, to whom the Trustees of the Australian Museum are indebted for many remarkable fishes not previously recognised from Australian waters.

Variation.—A specimen 78 mm. long differs from the larger example described above in having the spot on the caudal peduncle much darker and surrounded by a white ring. The soft dorsal and anal fins have each a narrow lemon-green border, within which is a narrow lavender line, and the caudal fin bears a broad cross-band of the same colour near its base.

C. rainfordi is very similar to *C. aureofasciatus* Macleay, which is also represented in Mr. Rainford's collection from Holbourne Island, but eight specimens of each of various sizes differ consistently in their colour-marking. The anterior bands of both are quite similar in both species, but, whereas the body is dark and uniform in *aureofasciatus*, it is light and conspicuously banded in *rainfordi*.

Locality.—Holbourne Island, off Port Denison, Queensland; holotype and seven paratypes.

CHAETODON AUREOFASCIATUS *Macleay.*

(Plate ii, fig. 2.)

Chaetodon aureofasciatus Macleay, Proc. Linn. Soc. N. S. Wales ii, 1878, p. 351, pl. viii, fig. 3; and v, 1881, p. 388. *Id.* Klunzinger, Sitzb, Akad. Wiss. Wien lxxx, i, 1879, p. 360. *Id.* Kent, Proc. Roy. Soc. Qld. vi, 1889, p. 239.

D.xi/22; A.iii/18; P.15; V.i/5; C.17. About 45 rows of scales between the origin of the lateral line and the hypural joint.

General form sub-circular; the depth from the tips of the erect dorsal spines to those of the anal greater than the length to the hypural joint. Anterior profile very slightly convex, but concave above the snout, which is a little prominent. Scales rounded; largest on the anterior portions of the sides and becoming much smaller posteriorly. They are arranged in sub-horizontal lines between the lateral line and the abdomen, but follow the curvature of the back above it. Lateral line terminating before the end of the soft dorsal fin.

Margin of the dorsal fin rounded; the median spines a little longer than the posterior ones; the base of the spinous portion is of the same length as that of the soft part. Anal rounded; the third spine longest. Ventral spine large, reaching the vent; the tip of the first ray reaches the base of the second anal spine. Caudal truncate.

Colours.—General colour yellowish with the greater portion of the sides brown, owing to a squamose pattern on the bases of the scales. A narrow orange stripe with lilac edges extends down the median line of the forehead to the upper lip. Ocular band orange, much narrower than the eye, with dark violet or blackish edges, exterior to which are ill-defined, pale lavender borders. An orange band commences above the shoulder and extends across the end of the operculum, across the base of the pectoral to behind the ventral fin. Its anterior edge is partly defined by a dark line and it is preceded by a broad lilac stripe. Dorsal, anal, and caudal fins bright yellow, the latter with a broad lavender border. Ventrals pale yellow tinged with green anteriorly. Younger specimens have an ill-defined dark patch on the caudal peduncle and a rounded dark area on the middle of each side below the lateral line.

Described and figured from a specimen 111 mm. long, from Holbourne Island. Registered I.A.269.

Localities.—*C. aureofasciatus* has hitherto been known only from Port Darwin district and a specimen is in the Australian Museum collection from that locality. A series of nine specimens, 73 mm. to 111 mm. long has been collected by Mr. E. H. Rainford at Holbourne Island and Hook Island near Port Denison, Queensland.

Family LABRIDAE.

PSEUDOLABRUS TETRICUS *Richardson.*

Pseudolabrus tetricus McCulloch, Rec. Austr. Mus. ix, 3, 1913, p. 377, pl. xix (synonymy).

Labrichthys cerulieus (Ogilby) Kent, Proc. Roy. Soc. Tasm. 1887 (1888), p. 47.

Labricthys ceruleus Kent, Nat. Austr., 1897, p. 174, pl. xxviii, fig. 17.

Cossyphus cerulæus (Ogilby) Johnston, Proc. Roy. Soc. Tasm. 1890 (1891), p. 35.

Synonymy.—The name *Labrichthys cerulieus,* credited to Ogilby by Kent, and changed to *Cossyphus cerulæus* by Johnston, is based upon a species which was described by Ramsay and Ogilby in 1887 as *Labrichthys cyanogenys.* No description appeared with the name *cerulieus,* but the characteristic colour-marking of *L. cyanogenys* is shown by Kent in his illustration of *L. ceruleus* quoted above. As *L. cyanogenys* is synonymous with *Pseudolabrus tetricus, L. cerelieus* must be added to the synonymy of that species also.

Family CALLIONYMIDAE.

Genus CALLIONYMUS.

Having examined several types and authentic specimens of species of this genus, together with a fine series of other specimens, I am able to submit the following key to the species recorded from Australia, together with the accompanying notes.

a. Preopercular spine almost straight and spear-like, with a row of spinules above, and an antrorse barb below. *Subg. Calliurichthys.*

b. Cranium with exposed rugose bones. *japonicus* and *affinis.*

bb. Cranial rugosities covered by skin.

c. 9 dorsal and 8 anal rays; dorsal rays mostly simple.

d. Snout little longer than the eye; upper lip projecting beyond the preorbitals when the mouth is closed. *grossi.*

aa. Preopercular spine with curved tip and one or more large hooks above; lower antrorse barb of preopercular spine present or absent. *Subg. Callionymus.*

e. Lower antrorse barb of preopercular spine present. Dorsal rays mostly simple.

f. Preopercular spine with only two recurved spines at the tip.

g. Cranium and supraorbital ridges smooth. *lunatus.*

gg. Cranium and supraorbital ridges with bony granules. *limiceps.*

ff. Preopercular spine with 3-5 recurved hooks above.

h. Margin of first dorsal fin rounded; the first spine not longer than the second. *calcaratus* and *macdonaldi.*

hh. Margin of first dorsal somewhat excavate, first spine longer than second. *valenciennesii.*

ee. Preopercular spine without a lower antrorse barb; dorsal rays branched.

i. Lateral line arched anteriorly, extending along middle of sides posteriorly.
j. Preopercular spine with two terminal hooks.
k. 7-8 anal rays. *calauropomus.*
kk. 6 anal rays. *papilio.*
jj. Preopercular spine with three hooks; 8-9 dorsal and 7 anal rays.
l. Eye about one-third length of head. *phasis.*

CALLIONYMUS, CALLURICHYTHYS, JAPONICUS *Houttuyn.*

Callionymus japonicus (Houttuyn), Jordan & Fowler, Proc. U.S. Nat. Mus. xxv, 1903, p. 942, fig. 2 (synonymy).
Callionymus reevesii Richardson, Ichth. Voy. "Sulphur," 1844, p. 60, pl. xxxvi, figs. 1-3 (not fig. 4).
Callionymus longicaudatus Schlegel, Faun. Japon., Poiss., 1845, p. 151, pl. lxxix, fig. 1. *Id.* Günther, Challenger Zool. i, 1880, p. 44. *Id.* Waite, Prelim. Rept. Thetis. Exped., 1898, p. 60.
?*Callionymus affinis* Ogilby, New Fish Qld. Coast, 1910, p. 134 (not *C. affinis* Regan).

This species has been recorded from station 188, between New Guinea and Australia, in the Challenger Report, and from Lord Howe Island by Waite. Four specimens from the latter locality, in the Australian Museum, exhibit considerable variation in the lengths of the dorsal spines and caudal rays, but are very similar to Richardson's figures of *C. reevesii.*

C. affinis Ogilby (not of Regan, 1908) was described from a single specimen from off Cape Moreton, Queensland, which, apparently, has since been lost. The name is preoccupied, but, as the species is probably identical with *C. japonicus*, there is no necessity to propose a substitute.

CALLIONYMUS, CALLIURICHTHYS, GROSSI *Ogilby.*

Callionymus grossi Ogilby, Proc. Roy. Soc. Qld., xxiii., 1910, p. 43.

A specimen, 115 mm. long, identified by Ogilby, is in the Australian Museum from Cape Moreton.

CALLIONYMUS LUNATUS *Schlegel.*

Callionymus lunatus (Schlegel), Jordan & Fowler, Proc. U. S. Nat. Mus. xxv, 1903, p. 949, fig. 5 (synonymy). *Id* Günther, Challenger Zool. i, 1880, p. 28.

A specimen was obtained in Port Jackson by the Challenger Expedition which Günther identified as *C. lunatus*, but, as no other having the characters of that species has since been obtained in New South Wales waters, it seems probable that the identification was incorrect.

CALLIONYMUS VALENCIENNESI *Schlegel.*

Callionymus valenciennesi (Schlegel), Jordan & Fowler, Proc. U. S. Nat. Mus. xxv, 1903, p. 950 (synonymy).

Localities.—Apparently incorrectly recorded from Australian waters. Four specimens from Japan are preserved in the Australian Museum.

CALLIONYMUS MACDONALDI *Ogilby.*

Callionymus macdonaldi Ogilby, Ann. Qld. Mus. 10, 1911, p. 56, pl. vi, fig. 2.

Locality.—Moreton Bay, Queensland (Ogilby).

CALLIONYMUS PHASIS *Günther.*

Callionymus phasis Günther, Challenger Zool. i, 1880, p. 28, pl. xv, fig. c.

Two specimens, 48 and 66 mm. long, exhibit some variation in the lengths and numbers of their fin-rays and spines. In the larger the dorsal spines are much longer than the rays as in the holotype, but in the other the longest spine is a little shorter than the anterior rays. The latter has nine dorsal rays while the former has only eight; both have seven anal rays.

Locality.—Gippsland Coast, Victoria, 80 fathoms.

CALLIONYMUS LIMICEPS *Ogilby.*

(Plate iii, fig. i.)

Callionymus limiceps Ogilby, Ann. Qld. Mus. 9, 1908, p. 35.

D.iv/9(10); A.9(10); P.20; V.i/5; C.9. Depth (15.3 mm.) 10.4 in the length of the hypural joint (160); breadth before pectorals (35) 4.5 in the same. The distance between the premaxillary symphysis and tip of preopercular spine (43) 3.7 in the length. Eye (10) 1.5 in the preorbital width (15).

Cranium covered by a large rugose plate. Supraorbital ridges granular; the space between them deeply concave. Preopercular spine curved upward at the tip with a single recurved hook on its upper margin and a strong antrorse spine near its base. Upper lip projecting well beyond the preorbital when the mouth is closed. Maxillary extending backward to below the nostril, which is placed a short distance in front of the eye. A band of villiform teeth in each jaw.

The two anterior spines of the first dorsal fin are filamentous, the first reaching backward beyond the base of the last ray; the third equals the length of the first ray. The dorsal rays decrease in length from the first to the fourth and then increase again backwards, the

last reaching the base of the tail; all are simple except the last, both branches of which are bifurcate. Anal rays increasing in length backward, otherwise similar to those of the dorsal. Upper portion of pectoral fin emarginate, the lower rounded; all but the outer rays are bifurcate. The ninth is longest and reaches the length of the second anal ray. Ventrals reaching backward almost to the level of the first anal ray. The outer caudal ray is single; the others bifurcate.

Colour.—Brown above, closely speckled with brown spots of varying sizes; these form short lines which extend obliquely forward below the eye and they are enlarged along the sides of the body. First dorsal with a large black spot on the third spine which is surrounded by angular grey stripes. The two filamentous spines with numerous grey annuli. Second dorsal with a narrow inframarginal white streak and numerous round spots; some larger dark brown spots on the lower half of the fin. Caudal ornamented with many small white spots between the rays and some darker ocellated spots. Anal with a broad dusky margin. Pectorals and ventrals with irregular rows of grey dots; the latter with a dusky border.

Described and figured from a specimen 216 mm. long from near Cape Capricorn, Queensland.

Variation.—A series of eighteen specimens exhibits some slight variation in the colour-marking, some being much lighter than the others, having the brown spots on the head and body less distinct; those on the body may tend to form rings surrounding imperfect ocelli, or they may be reduced to very small dots. The armature of the preopercular spine and the general form of the cranial armature is similar in all.

Sexual dimorphism.—The females are readily distinguishable from the males by the size of the anal papilla and by the form of the first dorsal fin. In the females the anal papilla is small, whereas it is large in the males reaching backward almost to the origin of the anal fin. The two anterior dorsal spines are greatly elongated in the male, but in the female they are usually much shorter than the anterior dorsal ray; the black spot on the first dorsal fin is much smaller in males than in females, though its size varies considerably in the latter.

Locality.—Eighteen specimens, 147 mm. to 224 mm. long, were trawled by the "Endeavour" at several stations between Hervey Bay and Port Denison, Queensland, at various depths between 13 and 26 fathoms.

CALLIONYMUS CALCARATUS *Macleay.*

(Plate iii, fig. 2.)

Callionymus calcaratus Macleay, Proc. Linn. Soc. N. S. Wales v, 1881, p. 628. *Id.* Ogilby, Proc. Linn. Soc. N.S. Wales x, 1885, p. 121.

Callionymus curvicornis Ogilby, Cat. Fish. N. S. Wales, 1886, p. 37. *Id.* Stead, Proc. Linn. Soc. N. S. Wales xxv, 1900, p. 476. *Id.* Waite, N. S. Wales Nat. Club Mem. ii, 1904, p. 51 (not *C. curvicornis* Cuv. and Val.).

Callionymus reevesii Ramsay & Ogilby, Proc. Linn. Soc. N. S. Wales (2) i, 1886, p. 942. *Id.* Waite, N. S. Wales Nat. Club Mem. ii, 1904, p. 51 (not *C. reevesii* Richardson).

D.iv/9(10); A.9/10; P.20; V.i/5; C.9. Depth (23 mm.) 7.9 in the length to the hypural joint (183 mm.); breadth before the pectorals (38) 4.8 in the same. The distance between the premaxillary symphysis and the tip of the preopercular spine (47) 3.8 in the length. Eye (10) 1.5 in the preorbital width (15).

Head smooth above without exposed rugose bones. Preopercular spine curved upwards at the tip with three recurved hooks on its upper margin, and a lower antrorse spine near its base. Upper lip projecting slightly beyond the preorbital when the mouth is closed. Maxillary extending backward below the nostril, which is placed a little in advance of the eye. A band of villiform teeth in each jaw.

The first dorsal fin with the margin rounded, its longest spine much shorter than the anterior ray. Most of the dorsal rays are simple, but each branch of the last one is bifurcate. Anal similar to the second dorsal. Upper portion of the pectoral fin emarginate, the lower rounded; all but the outer rays are bifurcate; the ninth is longest and reaches the level of the second anal ray. Ventrals reaching backward to the level of the vent. Caudal rays mostly bifurcate.

Colour.—General colour citrinous yellow above, closely speckled with pale grey ocelli of all sizes. The colours are more pronounced on the head, where they are interspersed by lighter yellowish marbling. Sides below lateral line silvery with a median series of greyish blotches and descending lines of yellow-bronze. Lower parts white. First dorsal citrinous brown anteriorly with bluish spots; the rest of the fin with a large black spot on a white ground. Second dorsal hyaline, with numerous brownish dots and pencillings and milk-white spots between the rays. Caudal similar to second dorsal, the lowermost rays white; a dusky stripe along the lower portion. Margin of anal milk-white, the rays a little darker, with indefinite dusky marks between the rays. Ventrals citrinous, with deeper pencillings and a narrow white margin. Upper half of pectoral with darker spots on the rays, the lower half plain.

Described and figured from a specimen 242 mm. long, from Port Jackson.

The four typical specimens in the Macleay Museum have nine instead of eight anal rays as described. The strong spur described by Macleay as being on "the posterior half of the outer side" of the preopercular spine, and "pointing backwards" is on the basal half

of the spine and is directed forward; the three upper barbs likewise curve forward, not "backward." These errors in Macleay's description have already been noted by Ogilby (1885).

Synonymy.—Ogilby (1886) united *C. calcaratus* with *C. curvicornis* Cuv. & Val., and *C. valenciennesii* Schlegel, but there appears to be reason to maintain it as a valid species. I have compared specimens of *C. calcaratus* with four Japanese examples of *C. valenciennesii* and find the spinous dorsal of the former to be rounded, with the first spine never longer than the second, whereas it is longer than the second in *valenciennesii* and so makes the margin of the fin appear somewhat excavate. The black spot on the first dorsal, when present, occupies the space between the second and fourth spines in *calcaratus*, and is confined to that between the third and fourth in *valenciennesii*. *C. curvicornis* has not been sufficiently well described to permit of a comparison with it, but there is little likelihood that the southern Australian fish is identical with that from Bourbon.

Ramsay & Ogilby (1886) have recorded a specimen from Port Jackson as *C. reevesii* Richardson (part) which is apparently synonymous with *C. valenciennesii*. No specimen so labelled is now preserved however, and I do not find any entered under that name in the Museum registers, so am led to believe that the record was based upon a specimen of *C. calcaratus*.

Localities.—Four specimens, 120-243 mm. long, are in the Australian Museum from Port Jackson, and two others from Houtmans Abrolhos, Western Australia. Macleay's types are from Port Jackson.

CALLIONYMUS CALAUROPOMUS *Richardson.*

Callionymus calauropomus Richardson, Ichth. "Erebus" and "Terror," 1844, pp. iv and 10, pl. vii, fig. 4-5. *Id.* Günther, Brit. Mus. Cat. Fish. iii, 1861, p. 147, and Challenger Zool. i, 1880, p. 28. *Id.* Klunzinger, Arch. Naturg. xxxviii, i, 1872, p. 31, and Sitzb. Akad. Wiss. Wien lxxx, i, 1879, p. 386. *Id.* Castlenau, Proc. Zool. Soc. Vict. ii, 1873, p. 49, and Res. Fish. Aust. (Vict. Offic. Rec. Philad. Exhib.) 1875, p. 21. *Id.* Macleay, Proc. Linn. Soc. N.S. Wales v, 1881, p. 627. *Id.* Ogilby, Cat. Fish. N.S. Wales, 1886, p. 37. *Id.* McCoy, Prodr. Zool. Vict. dec. xx, 1890, pl. excii. *Id.* Lucas, Proc. Roy. Soc. Vict. (2) ii, 1890, p. 29. *Id.* Woodward, West. Austr. Year-book, 1900-1 (1902), p. 271. *Id.* Waite, N.S. Wales Nat. Club Mem. ii, 1904, p. 51. *Id.* Ogilby, Proc. Roy. Soc. Qld. xxiii, 1910, p. 48. *Id.* McCulloch and Waite, Rec. S. Austr. Mus. i, 1918, p. 48.

Callionymus achates De Vis, Proc. Linn. Soc. N.S. Wales vii, 1883, p. 620.

Ten specimens from Port Jackson, 90-280 mm. long, show that this species is readily recognisable by its branched dorsal rays and the form of the preopercular spine, which terminates in two barbs; only one specimen has a minute extra barb on each side. D.iv/8; A.7-8.

Distribution.—Richardson gave Western Australia (p. iv.) as the locality for his type, but Günther later quoted it as North-west Australia. However, as the species is common in Victoria, New South Wales, and South Australia, it is probable that Günther was in error. According to Ogilby (1910), *C. achates* De Vis is founded upon a female of *C. calauropomus*, in which case the species ranges northward to Queensland.

The specimen recorded from 115 fathoms near the Philippine Islands by Günther,[1] and that from New Ireland by Peters[2] were clearly incorrectly identified.

CALLIONYMUS PAPILIO *Günther.*

Callionymus papilio Günther, Ann. Mag. Nat. Hist. (3) xiv, 1864, p. 197. *Id.* Macleay, Proc. Linn. Soc. N.S. Wales v, 1881, p. 627. *Id.* Ogilby, Cat. Fish. N.S. Wales, 1886, p. 37. *Id.* Lucas, Proc. Roy. Soc. Vict. (2) ii, 1890, p. 29. *Id.* Waite, N.S. Wales Nat. Club Mem. ii, 1904, p. 51. *Id.* Fowler, Proc. Acad. N. Sci. Philad., 1907 (1908), p. 442.

Callionymus ocellifer Castlenau, Proc. Zool. Soc. Vict. ii, 1873, p. 49.

Callionymus lateralis Macleay, Proc. Linn. Soc. N.S. Wales v, 1881, p. 628 (not *C. lateralis* Richardson). *Id.* Johnston, Proc. Roy. Soc. Tasm., 1890 (1891), p. 33.

Callionymus macleayi Ogilby, Cat. Fish. N.S. Wales, 1886, p. 37—substitute name. *Id.* Waite, N.S. Wales Nat. Club Mem. ii, 1904, p. 51.

Synonymy.—The identity of *C. ocellifer* Castlenau and *C. papilio* was recognised by Macleay. The types of the former are preserved in the Paris Museum, and photographs of them, which have been forwarded to the Australian Museum, clearly show the characteristic colour-markings on the fins and body and agree with specimens from Port Jackson which I identify as *C. papilio.* One has eight instead of seven dorsal rays.

The holotype of *C. lateralis* Macleay is preserved in the Macleay Museum, and differs from its description in having seven dorsal and six anal rays instead of eight in each fin. It is similar to others in the Australian Museum, and is clearly the young of *C. papilio.*

Distribution.—New South Wales, from Port Jackson southward to Victoria and Tasmania.

[1] Günther—Challenger Zool. i, 1880, p. 53, and *Ibid.* xxii, 1887, p. 70.

[2] Peters—Monatsbr. k. Akad. Wiss., Berlin, 1876, p. 841.

FISHES FROM LORD HOWE ISLAND.

Family OPHICHTHYIDAE.

Genus CALLECHELYS *Kaup.*

CALLECHELYS MARMORATUS *Bleeker*

Callechelys marmormatus (Blkr.) Weber, Fish. Indo-Austr. Arch. iii, 1916, p. 288, fig. 132.

A fine specimen 466 mm. long forwarded by Mr. R. E. Baxter, resembles the form figured by Snyder as *C. luteus.*

Locality.—Lord Howe Island.

Family TRACHICHTHYIDAE.

HOPLOSTETHUS ELONGATUS *Günther.*

TRACHICHTHYS ELONGATUS Günther, Challenger Rept., Zool. xxii, 1887, p. 22, pl. v, fig. c. *Id.* Waite, Mem. Aust. Mus. iv, 1, 1899, p. 64.

Two specimens were found on the lagoon beach at Lord Howe Island by Mr. R. E. Baxter. Several others are in the Australian Museum from off Norah Head and off Botany Bay, New South Wales, 26-38 fathoms, where the species is occasionally captured by the trawlers.

Family STROMATEIDAE.

CUBICEPS *Lowe.*

CUBICEPS Regan, Ann. Mag. Nat. Hist. (7) x, 1902, p. 122 (revision).

The genus *Ariomma* Jordan & Snyder, has been regarded as synonymous with *Cubiceps* by Regan, Brit. Antarc. Exped., Zool. i, 1, 1914, pl. 20, but it apparently differs in having adipose eyelids, while the palate is toothless.

Key to the species of *Cubiceps*:—

a. 20-23 dorsal and 19-21 anal rays.
- *b.* Depth of body 4-4½ in length to hypural joint. — *gracilis.*
- *bb.* Depth greater than one-fourth the length to the hypural joint.
  - *c.* Premaxillary concealed by preorbital when mouth is closed; 60 or more scales on lateral line.
    - *d.* Caudal peduncle about twice as long as deep. — *capensis.*
    - *dd.* Caudal peduncle almost as deep as long. — *baxteri.*
  - *cc.* Premaxillary not entirely concealed by preorbital when mouth is closed; about 52 scales on lateral line. — *caeruleus.*

aa. 14-17 dorsal and 14-15 anal rays.
- *e.* Pectoral fin longer than the head. — *pauciradiatus.*
- *ee.* Pectoral fin shorter than the head. — *brevimanus.*

CUBICEPS CAERULEUS Regan.

(Plate i, fig. 3.)

Cubiceps caeruleus, Regan, Ann. Mag. Nat. Hist. (8) xiii, 1914, p. 15, and Brit. Antarc. Exped., Zool. i, 1, 1914, p. 19.

Cubiceps gracilis, Waite, Rec. Austr. Mus. v, 3, 1904, p. 162. (Not *C. gracilis*, Günther.)

Characters.—D.xi-i/21; A.iii/21; V.i/5; P.21; C.17. About 52 scales on the lateral line to the hypural joint. Depth (25 mm.) 3.1 in the length to the hypural joint (79); head (22.5) 3.5 in the same. Eye (7.2) 3.1, and depth of caudal peduncle (8) 2.8 in the head. Snout (5.3) 1.3 in the eye, and 1.2 in the interorbital width (6.8). Pectoral fin (25.5) 0.13 longer than the head, its length subequal to the depth of the body.

Maxillary not quite reaching the vertical of the anterior margin of the eye when the mouth is closed. Opercles membranaceous, their surfaces with radiating striæ. Supraclavicle and clavicle bones exposed and striate. Each jaw with a single row of small cardiform teeth; a small patch of similar teeth on the vomer, and one or two on the anterior portion of each palatine.

Most of the scales are missing; those remaining are thin, with their surfaces concentrically striated. They covered the greater part of the head, the bases of the anal and caudal fins, and evidently that of the second dorsal also. Lateral line following the curve of the back; a groove extends along the middle of each side from the shoulder to the caudal peduncle. Fin-rays imperfect; the pectoral reaches a trifle beyond the vertical of the origin of the anal fin.

Identity.—The specimen here characterised and figured was identified by Waite as *C. gracilis*, but it apparently differs from that species in being considerably broader and in having a shorter maxillary and fewer scales on the lateral line. It is evidently referable to *C. caeruleus*.

Locality.—Lord Howe Island.

CUBICEPS BAXTERI, *sp. nov.*

(Plate i, fig. 4.)

D.xi/23; A.iii/21; P.23; V.i/5; C.?. About 62 scales on the lateral line between its origin and the hypural joint; 5 between the first dorsal spine and the lateral line, and 21 more to the vent.

Depth of body 3.7 in the length to the hypural joint; head 3.2 in the same. Eye almost as wide as its distance from the premaxillary symphysis, a little narrower than the interorbital width, and 3.7 in the head. Snout 3.5, interorbital space 3.2 in the head. Pectoral fin 0.2 longer than the head. Ventral fin 2.5, second dorsal and anal rays 3.8, depth of caudal peduncle 3.2 in the head.

Though now greatly denuded, the head has been largely covered with scales which extended onto the preorbital bone, mandible, and throat; the anterior portion of the snout, and its sides backward to the eyes is naked. The opercular bones are membranaceous and unarmed; preopercular edge entire and free, its angle produced backward as a broad rounded lobe; operculum and suboperculum denuded of scales, their surfaces with fine radiating ridges. Rows of mucigerous canals extend backward from the snout, above the eye, to the suprascapular region, and all the fleshy parts of the head are closely pitted with small pores beneath the scales. The eye is large, surrounded by a soft skinny margin, without adipose eyelids. Interorbital space convex. Snout tumid, markedly convex, its upper profile forming an even curve with the head and back. Nostrils two simple openings placed close together near the end of the snout. Maxillary rounded posteriorly, not reaching the vertical of the anterior margin of the eye. Jaws subequal in length, each with a single row of small, somewhat curved, cardiform teeth; a small patch of similar teeth is present on the anterior part of the vomer, from which a single row extends backward along the median line of the palate; a short row of teeth on each palatine. The tongue is smooth and broadly rounded. Gill-openings extending well forward, the membranes free from the isthmus. Pseudobranchiæ present; a slit behind the fourth gill-arch. Eighteen gill-rakers on the lower limb of the first arch, the length of those near the posterior angle a little less than one-third the diameter of the eye.

The body is somewhat compressed, but with the dorsal and ventral surfaces rounded. It was evidently entirely covered with thin cycloid scales of moderate size, which extend onto the bases of the dorsal and anal fins. Lateral line curved upwards anteriorly and subparallel with the back. First dorsal originating a little before the vertical of the ventral spine. The third spine is longest, and the membrane from the last terminates just before the first ray. The second dorsal is elevated anteriorly, but is much lower than the first. The anal is similar in form to the second dorsal, but originates farther back. The pectoral is very large, extending backward well beyond the anterior portion of the anal. Ventral rather small, not reaching the vent, the spine weak and slender. Caudal detached from the specimen and incomplete, but evidently deeply forked.

Colour.—General colour dark brown, the vertical fins and the ventrals blackish; pectorals lighter.

Described and figured from an imperfect specimen, 371 mm. long without the tail. Most of its scales are missing, but some remain on the sides of the posterior portion of the body, and its caudal fin has become detached from the hypural bone, which is exposed.

Affinities.—This species is closely allied to *C. capensis* Smith,[3] but apparently differs in having the caudal peduncle much shorter,

[3] Smith, Zool. S. Africa, Pisces, 1849, p. —, pl. 24.

the pectoral fin longer, and the longest dorsal spine much higher than the third ray. Smith's figure may not represent these characters accurately, however, and I am unable to refer to a later illustration of the species published by Ariola.[4]

Locality.—Lord Howe Island. The specimen was found stranded on a beach after a gale by Mr. R. E. Baxter, to whom the Trustees are indebted for many rarities from the island.

Family LABRIDAE.

INIISTIUS PAVONINUS *Cuv. & Val.*

Xyrichthys pavoninus Cuv. & Val., H.N. Poiss. xiv, 1839, p. 63.

Iniistius pavoninus Jord. & Evm., Bull. U.S. Fish. Comm. xxiii, i, 1905, p. 329, fig. 139, pl. xlii (synonymy).

Iniistius cacatua Waite, Rec. Austr. Mus. iv, 1, 1901, p. 41, pl. vii.

Synonymy.—A comparison of the holotype of *I. cacatua*, with a smaller Hawaiian example, which is evidently *I. pavoninus*, shows them to be very similar in all details except the position of the anterior dorsal spine. This is a little farther back in the larger example, but is not so far back as is illustrated in Waite's rather crude figure, which is inaccurate in other details such as the backward extension of the mouth and the relative length and depth of the head.

Localities.—Lord Howe Island; holotype of *I. cacatua*. Honolulu, Hawaiian Islands.

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[4] Ariola, Revista mens. Pesca vii, 1912, p. 185, pl. —.

NOTES ON NEW ZEALAND FISHES.

By

Allan R. McCulloch, Zoologist, Australian Museum,

and

W. J. Phillipps, Dominion Museum, Wellington.

(Plate iv and Fig. 1.)

The following notes and figures are based upon specimens of several fishes from New Zealand waters, belonging to various families, which have been examined by us jointly.

Family Histiopteridae.

Pseudopentaceros richardsoni *Smith.*

(Plate iv, fig. 1.)

Pentaceros richardsoni Smith, Illustr. Zool. S. Africa, Pisces, 1849, pl. xxi. *Id.* Hutton, Trans. N. Zeal. Inst. xxii, 1890, p. 277.

A young example, 70 mm. long from the snout to the end of the caudal fin, is apparently referable to this species, though it differs considerably from the adult form as figured by Smith.

D.xiv/9-10; A.iv/8-9; P.18; V.i/5; C.17. The depth at the ventrals is 2.3 in the length to the hypural joint; head 2.7 in the same. Eye almost 3 in the head, slightly longer than the snout, and 1.2 in the interorbital width. Fourth dorsal spine 1.08, and ventral spine 1.1 in the head. All the exposed surfaces of the bones of the head and shoulder girdle are rugose with radiating spinate ridges, which are arranged as illustrated in the accompanying figure. A few small depressible teeth form a band in each jaw, and several similar teeth occur on the vomer; palatines toothless. The scales covering the cheeks and the body are minute and finely spinose, and the spines of the fins are coarsely carinate. The body bears numerous, well-defined, dark markings, which tend to form irregular rings, but they are differently arranged on each side. The spinous portions of the dorsal and anal fins and the whole of the ventrals are blackish.

Locality.—Nelson, New Zealand. Collected by Mr. F. G. Gibbs.

P. richardsoni was first recognised from New Zealand by Hutton, who identified specimens in the Canterbury Museum.

Family CHEIMARRICHTHYIDAE.

CHEIMARRICHTHYS FOSTERI *Haast.*

(Plate iv, fig. 2.)

Cheimarrichthys fosteri Haast, Trans. N. Zeal. Inst. vi, 1874, p. 103, pl. xviii. *Id.* Waite, *Op. Cit.* xlii, 1909, p. 390, pl. xxxviii.

"Papanoko" Mair, Trans. N. Zeal. Inst. xii, 1880, p. 315. *Id.* Best, *Op. Cit.* xxxv, 1903, p. 78.

Localities.—This species was originally described from the Otira River on the western slopes of the dividing range of the South Island of New Zealand, but Waite has recorded its occurrence in several eastern streams also. Under its native name "Papanoko" it was first recognised from the Wanganui River in the North Island by Mair, while Best also records it from the Bay of Plenty district.

Maoris at Hiruharama on the Wanganui River were recently found to be securing this species in large numbers. Two examples collected by Mr. Elsdon Best were submitted to us for examination.

A comparison of North and South Island specimens, from the Wanganui and Rakaia Rivers, reveals no characters to distinguish them even subspecifically.

Family CHIRONEMIDAE.

CHIRONEMUS MARMORATUS *Günther.*

Chironemus marmoratus Günther, Brit. Mus. Cat. Fish. ii, 1860, p. 76. *Id.* Ogilby, Ed. Fish. N.S. Wales, 1893, p. 54, pl. xvii.

Haplodactylus fergussoni Hector, Trans. N. Zeal. Inst. vii, 1875, p. 243.

Chironemus fergussoni Hector, Trans. N. Zeal. Inst. ix, 1877, p. 467, pl. viii, fig. 8a.

A specimen, 330 mm. long, from the Bay of Islands, New Zealand, is evidently referable to *C. fergussoni,* which species was described by Hector from examples obtained at the same locality and at East Cape. This specimen is rather more slender than others of *C. marmoratus* from Port Jackson, New South Wales, but as it agrees with them in all structural details and in its colour-marking, we are unable to find any satisfactory characters to distinguish the New Zealand from the Australian species.

The specimen from the Bay of Islands has the following characters:—D.xiv/18; A.iii/7 (8); P.15, six lower rays simple. Lateral line with 56 pierced scales to the hypural joint, and 3 more on the base of the tail.

Family SYNGNATHIDAE.

STIGMATOPHORA LONGIROSTRIS, *Hutton*.

(Fig. 1.)

Stigmatophora longirostris Hutton, Fish. N. Zeal., 1872, p. 69.

D.65; P.17; Rings 21/54. Head 1.5 in its distance from the vent; head and trunk 2.1 in the tail. Snout 1.1 longer than the rest of the head; eye 2.2 in the postorbital portion of the head. Operculum with a horizontal ridge. Dorsal fin commencing on the eighth body-ring, and a little nearer the operculum than the vent; it extends over thirteen body-rings and twelve tail-rings.

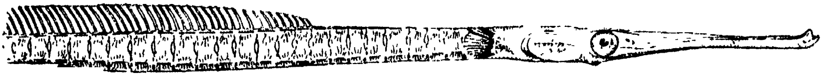

Fig. 1.

A somewhat damaged specimen, 250 mm. long, is evidently identical with Hutton's species, though it differs in several details from his description.

Locality.—Portobello, Port Chalmers; 29th Sept., 1918.

Family BLENNIIDAE.

TRIPTERYGION SEGMENTATUM, *sp. nov.*

(Plate iv, fig. 3.)

Br.6; D.iv, xvii, 12; A.25; P.16; V.2; C.15. L. lat. 23 + 18. Depth at the ventrals equal to about one-fifth of the length to the hypural joint; head 3.6 in the same. Eye about 3 in the head, its diameter greater than the depth of the caudal peduncle.

Head naked, with rather large pores and mucigerous canals around the eye and preopercular margin, across the nape, and on the interorbital area and the snout. Snout pointed, the jaws subequal; mouth oblique, the maxilla extending backward to below the anterior portion of the eye. Anterior nostril in a low tube, with an upstanding tentacle; posterior nostril a large opening near the upper margin of the eye. Eye large, its upper margin cutting the profile of the head; a short ocular tentacle projects from its upper portion. Interorbital space narrow, mesially grooved. Preopercular margin free and entire, with large open pores. Operculum rounded, unarmed. Gill-membranes produced into pointed lobes above the bases of the pectorals, and broadly united across the throat in front of the ventrals.

Body compressed, largely covered with scales, which have coarsely ciliated edges and their exposed surfaces concentrically striated. The space between the lateral line and the back is naked, as is the breast and abdominal surface. The tail is scaly on the sides, but has its dorsal and ventral surfaces naked. There are five rows of scales between the posterior dorsal and anal rays. Lateral line parallel with

the back, formed of coarse simple tubes and extending backward to the space between the second and third dorsal fins; a single row of scales separates it from the median row, in which each scale has a small marginal notch.

First dorsal commencing above the operculum; its first two spines are of subequal length, and the others decrease backward; the third is united by membrane to the first spine of the second dorsal. The spines of the second dorsal attain their highest point at about the fourth, and then decrease slightly backwards; the membrane from the last apparently touches the base of the first ray of the third dorsal. All the rays of the third dorsal are simple; the third is longest and the others decrease backward; the last is double. Anal originating in advance of the middle of the second dorsal and terminating behind the last ray of the third dorsal; all its rays are simple, and they increase gradually in height to about the fourth last. Pectorals large, pointed, and entirely composed of simple rays; the lower rays are somewhat thickened, and the seventh is longest. Ventrals jugular, each with a fixed spine and two simple thickened rays. Caudal imperfect, apparently rounded, and composed of simple rays.

Colour-marking.—Light yellowish after preservation, with eight broad, dark cross-bands descending from the back to the ventral surface; four of these are below the second dorsal and three below the third, while one crosses the caudal peduncle. The intermediate spaces are covered with grey dots near the back, which leave light borders on each side of the dark bands. There is a dark bar descending from the eye, another across the lips, and a cluster of dots forms a dark patch on the operculum. The dorsal fins have dark areas corresponding to the body bands, which coalesce on the upper parts of the fins. Anal dark, with a blackish dot at the base of each ray.

Described and figured from a single specimen about 21 mm. long.

This species differs from others of the genus recorded from New Zealand in having all its fin-rays simple, the spines of the first dorsal decreasing instead of increasing in height backwards, and in its striking colour-marking. The two first mentioned characters suggest affinity with *Notoclinus* Gill, but in that genus the second dorsal is shorter than the third and the pectoral rays are less numerous than in this new species.

Locality.—Shag Point, Otago, New Zealand. Under stones at low-water mark. Collected by Mr. W. R. B. Oliver.

TRIPTERYGION VARIUM *Bloch & Schneider.*

Tripterygion varium (Bloch & Schneider) Waite, Rec. Cantb. Mus. ii, 1, 1913, p. 7, pl. iii.

Sixteen specimens, 58-83 mm. long, exhibit considerable variation in the numbers of fin-rays and spines. Ten specimens counted have D.v-vi, xx-xxi, 13-15; A.25-29.

Locality.—Portobello, Port Chalmers, on the beach, 5th-6th December, 1918.

HELCOGRAMMA MEDIUM *Günther*.

Tripterygion medium (Günther) Waite, Rec. Cantb. Mus. ii, 1, 1913, p 5, pl. ii.

Nineteen specimens, 40-89 mm. long.

Locality.—Pipikariti, near Port Chalmers, in rock-pools, 12th December, 1918.

A REVISION OF THE RATS OF THE GENUS *LEPORILLUS* AND THE STATUS OF *HAPALOTIS PERSONATA* KREFFT.

By

Ellis Le G. Troughton, Zoologist, Australian Museum.

(Plates v-vi.)

While on a collecting expedition on behalf of the Trustees of the Australian Museum, at various stations on the Trans-Australian Railway, I secured several specimens of a stick-nest building rat. This series, in association with specimens already in the Museum collection, has proved of such interest that I present the following conclusions derived therefrom, together with figures of the cranial and other characters of the species of the genus. I am also able to supply notes upon the habits, and a photograph of the nest, of some of these interesting creatures.

During an examination of rats of the short-footed "jerboa" type, I had the cranium of the type of *Hapalotis personata* Krefft removed, and am now able to submit a note upon its status.

I wish to express my especial indebtedness to Professor F. Wood Jones, who generously supplied authentic specimens of *L. jonesi* so soon as he became aware that I was working upon the species of *Leporillus*. Also to Mr. Oldfield Thomas for his encouraging interest and valued notes received in correspondence, dealing with various species of Muridae. Of the Museum staff, I am indebted to Mr. A. R. McCulloch for his very willing help, and to Mr. J. R. Kinghorn, who most kindly prepared the figures, with the help of his assistant, Mr. H. O. Fletcher.

Genus Leporillus *Thomas.*

Leporillus Thomas, Ann. Mag. Nat. Hist. (7) xvii, 1906, p. 83—Orthotype *H. apicalis* Gould; *Id. loc. cit.* (8) iii, 1909, p. 372 (footnote), and (8) vi, 1910, p. 606 (footnote).

First and second upper molars each with two internal cusps; postero-internal cusps absent. Lower m^1 and m^2 each with a posterior concavity, in which a distinct median supplementary cusp is placed. Hind feet with the usual six pads. Ears long. Skull without supra-orbital ridges.

Affinities.—This genus resembles *Rattus* and *Notomys* in having the same number of molar cusps on m^1 and m^2, but differs from the former in having much longer ears, and from the latter in having a short and broad hind foot with six interdigital pads, instead of a long and very slender foot with three to four pads.

Range.—West of the Lower Darling River in New South Wales; from Alice Springs to the Nullarbor Plains and Nuyts Archipelago in South Australia.

Key to the species.—

A. Fur of middle of belly not pure white, slate coloured at base. Tail not tipped with white. Depth of muzzle, midway between henselion and palatal foramina, not longer than the upper molar row, which is 9-10.5 mm.

a. Ear long, much longer than distance between rhinarium and posterior canthus of eye. Front edge of zygomatic plate straight and oblique. Foot slender, its width 6.0-6.6 in its length. Basal length of lower molar row 8.5 mm. *conditor.*

b. Ear short, slightly less than distance between rhinarium and posterior canthus of eye. Front edge of zygomatic plate more or less curved. Foot broad, its width 5.3-5.8 in its length. Basal length of lower molar row 9-9.7 mm. *jonesi.*

B. Fur of middle of belly pure white, white at base. Tail tipped with white. Front edge of zygomatic plate vertical. Depth of muzzle, midway between henselion and palatal foramina, longer than the upper molar row, which is 7.3 mm. *apicalis.*

LEPORILLUS CONDITOR *Gould.*

(Plates v-vi.)

Mus conditor Gould, in Sturt's Exped. Centr. Austr., i, 1849, p. 120, pl. i; and ii, app. p. 7.

Hapalotis conditor Gould, Mamm. Austr. iii, 1863, pl. vi. *Id.* Krefft, Cat. Mamm. Coll. Austr. Mus., 1864, p. 65.

Conilurus conditor Ogilby, Cat. Austr. Mamm., 1892, p. 118. *Id.* Le Souef, Austr. Zoologist, iii, 1, 1922, p. 15, pl. i-ii.

External Characters.—Fur of back soft, fine, and moderately thick; an admixture of slate grey fur which is buffy towards, and light brown at tips, and longer blackish hairs which are not so thickly distributed as the short pile.

General colour of back light yellowish-brown, grizzled with blackish-brown; between the ears the yellowish-brown is clearer. Sides becoming greyish-buff. Fur of belly slate grey at base, with buffy-white tips the basal colour shows through the lighter tips, which are whiter on the throat and darkest between the forelimbs, where there is a buff patch. Inside of leg (outside in skin) washed with buff; outside of legs and either side of vent tinged with ochraceous-buff. There is a blackish-brown patch on the wrist, formed of light brown hairs with whitish tips, continued as a narrow bar of colour on the outer side of the hand as far as the base of the outer digit, whence it spreads

out into a dark patch on the metacarpals; extreme outer and the inner side of hand buff; digits darker owing to an intermingling of darker hairs. Feet (Pl. v, fig. 1b) with a patch of dark brown hairs on the outer base of the heels (inner in skin), which is continued in a light, thin line of shading along the outer edge of the metatarsals, and spreads out over the base of the outer digit; this shading is composed of dark grey hairs with dull white tips; rest of upper surface of feet buffy-white save for dark shading at the base of, and on digits. Ear dark brown on the outside, the anterior third of which is well covered with dark brown hairs with lighter tips; the rest of the outer surface is more lightly haired save for some long, light coloured hairs at the postero-external base; the upper half of the inside evenly covered with light brown hairs. Tail dark brown above, changing rather sharply to light buffy-brown on the sides and underneath, the colours being influenced by the scaling, which is dark above and light below; it is evenly covered with hairs, not concealing the scales, which are dark brown, generally with lighter tips above, and cream coloured on the sides and undersurface; the hairs do not become noticeably longer at the tip.

Ear (Pl. v, fig. 1a) large, its length much greater than the distance between the rhinarium and the posterior canthus of the eye, and reaching to about the middle of the distance between the posterior canthus of the eye and the base of the ear; it is longer than the distance between the heel tip and the most distal (3rd) interdigital pad (Pl. v, fig. 1b). Tail shorter than the head and body, its length 1.1 in that of the latter. Foot narrow, its width, opposite the distal end of the inner metatarsal pad, 7 mm.; its length from the heel tip to the end of the longest digit 42 mm.; the width is 6 in the length.

Skull.—Comparatively light (Pl. v, figs. 1c-d). Muzzle long and narrow, its width at the level of the anterior end of the palatal foramina 1.5 in the depth, which is shorter than the upper molar row. Nasals long and slender, their breadth at the middle of their length 3.8 in their length. Interorbital region comparatively narrow, without very sharp angled edges and with the orbital surfaces of the frontals, from the preorbital processes to the fronto-parietal sutures, visible from above. Zygomatic plate narrow, its anterior edge straight but oblique, the base projecting forward and its upper angle gently rounded. Zygomatic arches expanded posteriorly, their breadth at the junction of the process of the squamosal with the jugal greater than the maximum breadth of the maxillary processes. Palatal foramina extending well beyond the level of the anterior roots of the molars, their length equal to that of a molar row. Palate narrow, its width between the second molars equal to that of one m^2. Bullæ large, opaque, their depth, measured obliquely from the bony tubercle above the external meatus to the lowest point of the ventral surface, 10 mm. The postero-lateral edges of the interparietal forming a broad V, the well-defined apex overhanging the median keel and upper edges of the supraoccipital. Mandible moderately heavy.

Dentition.—Incisors slender and light, each 1 mm. in breadth. Antero-internal cusps of upper m^2 and m^3 (Pl. v, fig. 1e) directed obliquely forward, being situated opposite the divisions and filling the angles between the molars; the cusps press closely against the posterior laminæ of m^1 and m^2. Lower molar row (Pl. v, fig. 1f):—the first lamina of m^1 with a deep outer antero-lateral indentation, its inner cusp widely separated from that of the next lamina; all other laminæ, except the hindmost, which is oval, are V shaped, owing to the marked pinching in at their middles and the strongly oblique postero-lateral direction of their inner and outer cusps. Between these cusps are well-marked re-entrant concavities; those behind the second lamina of m^1 and the first lamina of m^2 and m^3 show as deep pits when cleared of calculus, whereas in the concavities behind the posterior lamina of m^1 and m^2 there is placed a well-defined, rounded, median supplementary cusp. All the inner cusps are widely separated except those of m^3.

Dimensions before Skinning.—Head and body 197 mm.; tail 178; hind foot 44; ear 43.

Skull Dimensions.—Greatest length 45.4; breadth of zygomatic arch at broadest part of zygomatic processes 20.4; breadth at junction of the jugal with the processes of the squamosals 21; nasals 17.5 × 4.5; interorbital breadth 5; palatilar length 21.5; palatal foramina 9.2 × 4; breadth of brain-case 17.6; depth of bulla 10; molar series, upper 9.3, lower 8.5.

Specimen described.—Adult female. Australian Museum Collection, No. M.3062. Collected 11th October, 1921, by E. Le G. Troughton and J. H. Wright. A series of dried and spirit specimens also examined.

Variation.—The general colour of four dried skins does not display marked variation beyond that the young specimens are slightly darker dorsally, the light brown tint becoming stronger in the older specimens. Two specimens have a short fur of varying length intermingled with the slate grey of the under fur; this is presumably a new growth, being so short in parts that only the lighter tips are showing above the skin, whereas in other parts the young fur shows a slate grey base, the light brown tips appearing half-way up the slaty base of the old fur and giving the appearance of rings of colour.

Comparative measurements of four spirit specimens exhibit a slight variation in the ear length; in two it is equal to the distance between the heel tip and the most distal pads, while in another it reaches from the former point to the middle of the longest digit. Measurements of eight fresh specimens show the tail to be from 10 to 20 mm. shorter than the head and body. Foot narrow, its width on a level with the distal end of the inner metatarsal pad from 6 to 6.6 in its length.

Comparative measurements of five crania show that the muzzles and nasals vary considerably in relative proportions with age. In four skulls from the same locality on the Trans-Australian Railway the muzzles of the young are relatively broader than those of adults, the muzzle width ranging from 1.2 to 1.5 in its depth; the width of the nasals of the smallest are 3.3 in their length, whereas they are 3.8 in the largest; in an adult from the Lower Darling these characters agree with the younger examples of my series rather than with the adults. The zygomatic plate is somewhat variable in shape, but the oblique anterior edge, with its projecting base, is maintained. Upper and lower molars of five skulls do not vary except for slight changes in general appearance due to wearing down in the older specimens; basal length of upper rows 9-9.3, lower rows 8.5.

Comparison with Allies.—The slender feet and large ears of this species resemble those of *apicalis*, but it is easily distinguishable from the latter by the structure of the cranium and teeth; it also has slaty basal belly fur and no tail tuft, as opposed to the entirely white belly fur and white tufted tail of *apicalis*. My specimens of *conditor* may be readily distinguished from *jonesi* by the markedly shorter ear and heavier foot, as well as by the stouter skull of the latter.

Identity.—*L. conditor* was first secured by Sturt in 1844 during one of his exploring expeditions on the banks of the Lower Darling, about 45 miles from Laidley's Pond. Since that time very few specimens seem to have been taken. Referring to the species in 1921, Mr. Oldfield Thomas wrote "there is no specimen of it in the British Museum," and in 1922 he recorded, on my authority, that there were no specimens in Sydney that could be recognised as *authentic* examples of Sturt's *conditor*. However, I have since found a single specimen in the old collection of the Australian Museum, which is entered as No. 86 in the Museum's earliest register, compiled by Secretary Palmer about the year 1877; the specimen may reasonably be considered identical with one presented to the Australian Museum by Krefft in 1861[1] as a "Building Rat, *Hapalotis conditor*," and subsequently listed by him in 1864; it is said to be from the Lower Murray, and, though considerably faded and with an imperfect skull, is apparently specifically identical with specimens recently collected by myself between Ooldea and Fisher in South Australia. I have no doubt, therefore, that the specimen described above is correctly identified as *L. conditor*.

Synonymy.—In his valuable "List of Australian and Austro-Pacific Muridæ," 1916, p. 37, Longman incorrectly relegated *conditor* to the synonymy of *Conilurus albipes* and overlooked Ogilby's reference to the former. Not only are these two specifically distinct, but *conditor* proves to be referable to the genus *Leporillus*, the members of which are distinguished by dental characters from the genus *Conilurus*, to which *albipes* belongs.

[1] Aust. Mus. 8th Ann. Rept., 1861 (1862), p. 3.

Nests.—As noted by Sturt[2], the nest was first described by Mitchell[3], but that explorer apparently did not keep a specimen of the animal which made it. He incorrectly ascribed it to *C. constructor* Ogilby, which species is synonymous with *C. albipes*[4], but according to Gould[5], this latter species does not build any such nest. It is therefore clear that Mitchell's description applies to the nest of *C. conditor*, as recognised by Sturt and Gould.

According to Mitchell's description of the nest in the region around the Lower Darling River, it consisted of a stack of small branches worked around and interlaced with a small bush, the whole resembling a pile for a signal fire. According to Sturt's description of nests in the same region, they were in the form of a compact cone like a beehive, and are so figured by him and by Gould[6].

Nests found by myself in an area from five to twelve miles west from Ooldea, South Australia, were exactly as described by Mitchell and not as represented by Sturt and Gould. The discrepancy between the above authors' descriptions of the nests is doubtless accounted for by the fact that the structure varies in character according to the conditions of terrain and available material. As an instance of this, the nests which I found around Ooldea, built in the shallow depressions, or "dongholes," where there was ample vegetation, were about three feet high and firmly constructed around the base of a bush, whereas nests of the same species in the neighbourhood of Fisher, where dongholes and suitable bushes were not available, consisted of a comparatively flattened heap of sticks without definite cone-like shape or central support, and were placed over rabbit warrens in the open plain.

While stationed at Ooldea and Fisher on the Trans-Australian Railway, my assistant (J. H. Wright) and I had excellent opportunities for observing the nests and habitat of these interesting Murids. We tramped over three types of country within about fifty miles of Ooldea, situated on the edge of the vast Nullarbor Plain, where a remarkable contrast is shown between the mallee and stunted scrub growing on the sand waves eastward of Ooldea and the flat monotonous landscape which the train enters immediately west of the station and traverses for three hundred miles. There were no stick nests in the scrub around Ooldea, and, after walking a zig-zag course all one morning, we could not find a nest on the plain within several miles of the scrub; the railway gangers, who were most kind and gave every assistance,

[2] Sturt—Exped. Centr. Austr. i, 1849, p. 120.

[3] Mitchell—In Ogilby, Trans. Linn. Soc. Lond. xviii, 1, 1838, p. 127-8, and Three Exped. Int. E. Austr. i, 1838, p. 305, and ii, p. 261-2.

[4] *Vide* Gray, Ann. Mag. Nat. Hist. ii, 1839, p. 308.

[5] Gould—Mamm. Austr. iii, 1863, pl. i.

[6] Gould—loc. cit., pl. vi.

spoke of a nest about a mile from the station, but we could not find it, and it must have been an isolated one. This scarcity of nests close to the station may have been due to the aboriginals, who are not encouraged by the authorities to go farther west, and make a regular camp at Ooldea; food is generally scarce, and on the plain for several miles may be seen excavations where the natives have been digging out rabbits and bandicoots; the rats were doubtless eaten by the natives, who, according to observers, regard them as a delicacy; this would entail destruction of the nests, and account for their absence close in.

Scattered over the plain, for about twelve miles westward of Ooldea, are slight depressions which have the appearance of shallow lake beds, where the soil is softer and the monotonous blue bush gives place to thick rank grasses and stunted bush (Pl. vi, fig 1). These "oases," dongas or "dongholes," as they are called, watered only in times of heavy rain, must seem a veritable haven of refuge to the animals of the plains, which we found, to our relief, prone to congregate in them. The struggle for existence and accommodation must be very keen, and in one of the larger dongholes we saw striking proof of congestion, in a typical stick nest of *conditor* on the top of which was the nest of a Striped Brown Hawk, *Ieracidea berigora* V. & H. (Pl. vi, fig. 2). The rat's nest was of a typical shape, save that a neat depression at the apex of the cone housed the bird's three eggs; the association was a strange one, and it is difficult to surmise what pact or understanding reconciled these ill-matched householders. Bones littered about inside the rat's nest suggested a meat diet, and most rats are partial to eggs, while there are many records of the partiality of the Brown Hawks for small quadrupeds, such as marsupials and rats, as food.

The cone-like type of nest, such as found on the plain west of Ooldea, has been so well described by earlier writers that little remains to be written; one of the largest we observed was quite three and a half feet high, with a diameter of not less than five feet. All nests of this type examined had the grass nests within, and the "hole in the ground" underneath them described by Gould was of varying length, comparatively straight and did not descend to any depth; somewhat like a shallow rabbit burrow and not always entirely covered in, it may be used for food storage as suggested by Gould, as well as an additional hiding place. The nests are so firmly woven that we found dragging them apart a difficult and trying task in the heat and dust; the use of the trunk and limbs of a gnarled and stunted tree as a basis for the structure of interwoven sticks gives it an extraordinary strength, which is doubtless a protection from the dingoes, which travel over the plains in great numbers at certain seasons, as well as from the strong winds which prevail and would soon disperse a mere heap of light, dead sticks. A few nests were observed without any central support, though good ones were available, and these, though somewhat flattened, were more of the type described by Gould and very closely woven.

The first donghole searched contained one large nest which Wright proceeded to disturb, the writer waiting with gun poised. After several false alarms caused by rabbits rushing from the refuge, where they are seemingly quite at home, we caught our first glimpse of a living *conditor,* moving very rapidly. The rabbit-like appearance of this rat mentioned by various authors was heightened by its method of running; we had ample opportunity to observe that this was quite as in *Rattus*, and never jerboa-like as in *Notomys*. Having noted the rabbit warren to which the quarry had retreated, we burrowed after it with our hands and a small entrenching tool. On reaching the junction of two burrows, excitement became intense, and the rat, after several feints, sprang out with such velocity as to completely baffle its pursuers. This happened several times, but fortunately there is only a shallow layer of soft earth about two feet deep in the dongholes, under which is a hard stratum preventing the excavation of deep burrows, so that we eventually secured our largest specimen as it crouched in a burrow with several rabbits.

Some of the large dongholes contained as many as six nests, and, though one regretted destroying the results of so much industry, time was precious, and the holders so unwilling to leave their forts that it became necessary to realise Mitchell's simile of the "signal fire . . . used by the natives," by burning one of the nests to obtain a series of specimens. The rats, as they emerged, rose up firmly on their strong hind feet and surveyed the surroundings before darting to a rabbit burrow.

Twelve miles westward of Ooldea the dongholes gradually disappear, and the landscape at Fisher, about forty miles farther on, is flat and fairly well covered with stunted bushes about knee-high. Here the frail bushes do not provide either adequate central support or sticks strong enough for the cone-like type of nests, which are therefore built over rabbit warrens, and in many cases had small stones placed among and on top of the sticks for added security. These nests looked like deserted crows' nests, having none of the orderly shape of those nearer Ooldea, and we might have doubted that they were occupied had we not occasionally surprised a rat sunning itself on top of one of them. The rats were very alert, and the nests, being placed at the confluence of several rabbit burrows in the centre of a warren, provided many avenues for escape; we tried to shoot specimens, but they always disappeared before coming within range of our light gun. To dig for specimens amongst the ramifying burrows was impossible, and as the rats were very wary of traps, we congratulated ourselves upon having secured a series from about Ooldea.

This species, unlike *L. apicalis* and *C. albipes*, which have been observed to live in hollow trees, appears to prefer entirely plain country, requiring the nest for protection.

Enemies.—Other enemies, doubtless more dreaded than the dingoes mentioned above, are the Barn or Delicate Owls, *Tyto alba*, which live in the limestone caves or "blowholes" which are scattered over the Nullarbor Plain. Though the openings of these blowholes are sometimes too small to allow a man to enter, they usually open out into a fair-sized chamber, from which small crannies are given off; their name is derived from the surprisingly strong wind which blows up from the crannies and out through the openings above; according to popular report the air at times is drawn strongly inward, the change in the direction of the draught being attributed to the action of the tides, some sixty miles away. We found owls roosting in several of the blowholes and collected a great many of their castings, the majority of which contained complete skulls of *conditor*, as well as those of a *Notomys* and a *Phascogale*.

In other areas, apart from the species' dislike of being disturbed by sheep and cattle, the penchant of the aboriginals for it as a food must have been a considerable factor in its extermination. Professor Sir Baldwin Spencer in a letter to Mr. E. R. Waite quoted the statement of a friend who forwarded specimens of *conditor*: "I let the boys (*i.e.*, blacks) have an hour's sport burning out some of them and chasing the inhabitants, which are regarded as a delicacy; there were four or five in each mound we tackled." Doubtless such depredations and the advance of settlement have driven the species to the more inaccessible desert country; on the vast Nullarbor Plain, where there is no stock and the natives are unable to exist, the species thrives in great numbers.

Habits.—Mr. A. S. Le Souef has noted the peculiar method *L. conditor* has adopted of carrying the young, which are firmly attached by their mouths to the nipples of the parent. There are several references to such an attachment amongst various genera of native Murinæ, doubtless the earliest being that of Gould[7], who quotes, when writing of *Hapalotis albipes*, a note sent him by Sir George Grey during his Governorship of South Australia: "The specimen I send you, a female, had three young ones attached to its teats when it was caught. . . . While life remained in the mother they remained attached to her teats by their mouths, and grasped her body with their claws, thereby causing her to present the appearance of a marsupial minus the pouch. On pulling the young from off the teats of the dead mother, they seized hold of my glove with the mouth and held on so strongly that it was difficult to disengage them." Ogilby[8] has commented upon this note.

Writing upon *Uromys cervinipes*, Lönnberg[9], quoting Dr. Mjöberg's diary, writes of a female carrying four young ones "hanging attached at the nipples and dragging after her on the ground." After a ten minutes' chase the young ones had not let go their hold and did not do so until dropped into alcohol with the mother.

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[7] Gould—Mamm. Austr., 1863, pl. i.
[8] Ogilby—Cat. Mamm. Austr., 1892, p. 114-5.
[9] Lönnberg—Kungl. Sv. Vet. Akad. Handl. lii, 2, 1916, p. 4.

Describing *Uromys littoralis,* Lönnberg[10] refers to further notes by Dr. Mjöberg and writes "the two young ones remained attached to the teats, although the mother ran hither and thither on the beach for awhile before she was caught, and the young were dragged along the ground. The young are hairy and . . . the mouth is open and appears quite normal. It is not obliterated at the sides as in the marsupials for retaining the maternal nipple. It is thus evident that the young animal in the present case has the faculty of holding on to the teat of the mother by means of their own muscular strength and with the aid of their jaws, lips and teeth. I think that it is especially the latter which are important . . . they are naturally enough, not worn to chisel-shaped edges at the ends, in which case they would wound the mother: on the contrary they are, especially those of the upper jaw, blunt. The upper incisors are also a little diverging with their bluntly rounded extreme ends, and by this, no doubt, the young animal gets a firmer grip. . . . a remarkable biological fact . . . but there is, of course, not the slightest trace of any marsupial affinity indicated by this."

Localities.—Lower Murray; Ooldea and Fisher on the Nullarbor Plain, Trans-Australian Railway, South Australia.

Distribution.—This species appears to have had a very wide range, as it occurred on the Lower Darling as well as at the above localities. This range is now greatly restricted, and Krefft, giving the habitat as "The plains of the interior," wrote in 1864: "This animal has become exceedingly rare, and is only found in localities where it is not disturbed by sheep or cattle. I do not think that it occurs south of the Murray, where, according to the aborigines, it was found in large numbers not many years ago."

LEPORILLUS APICALIS *Gould.*

(Plate v, fig. 3.)

Hapalotis apicalis Gould, Proc. Zool. Soc., 1851, p. 126, and Mamm. Austr. iii, 1863, pl. ii. *Id.* Krefft, Cat. Mamm. Coll. Austr. Mus., 1864, p. 64. *Id.* Spencer, Horn Exped. ii, 1896, p. 11.

Conilurus apicalis Ogilby, Cat. Austr. Mamm., 1892, p. 116. *Id.* Waite, Proc. Roy. Soc. Vict. x, 2, 1898, p. 115, pl. v, figs. 1a-e.

Leporillus apicalis Thomas, Ann. Mag. Nat. Hist. (7) xvii, 1906, p. 83, and *loc. cit.* (9) viii, 1921, p. 433 and pp. 618-620.

External Characters.—In the Australian Museum Collection are three dried and mounted specimens, which, though old and somewhat faded, agree well with Gould's descriptions and figure, and are quite as described by Waite. The general colour of the back is well represented in Gould's figure; it is lighter and not so grizzled as in *conditor,*

[10] Lönnberg—loc. cit., p. 6.

owing to the darker hairs being lighter and not so numerous as in the latter species. The fur of the under surface from the chin to the vent is entirely white from base to tip. Hands white with a median brown oblique mark separating the white from the greyish-brown of the upper limb. Feet white, showing signs of the "dark" marking described by Waite; the marks are light brown and irregularly placed, the most consistent being a faint line running down the outer side of the metatarsals; the faint markings do not restrict the generally white colour of the foot to any definite pattern. Ears: outside covered with light brown hairs which are longer and darker on the anterior third; upper half of inside covered with light yellowish-brown hairs. Tail with basal three-fourths of upper surface brown, the colour narrowing to a thin line and fading out towards the apical fourth, around which the hairs are considerably lengthened, forming a pencil of white; entire under surface lighter.

Ear long; in two dried specimens the length is greater than the distance between the rhinarium and the posterior canthus of the eye and equal to the distance between the heel tip and the fourth interdigital pad. Tail, according to Waite's measurements, considerably longer than the head and body. Foot long and slender.

Skull.—Comparatively light and elongate; its upper profile comparatively straight and not much bowed in the nasal region. Muzzle deep, its width above the anterior end of the palatal foramina 1.6 in the depth, which is longer than the upper molar row. Breadth of the nasals at the middle of their length, 3.8 in the length. Interorbital region broad, with sharp angled edges and with very little of the orbital surface of the frontals visible from above. Front edge of zygomatic plate straight and vertical, its upper angle gently rounded. Zygomatic arches expanded posteriorly; according to Waite's figures their breadth at about the junction of the process of the squamosal with the jugal is considerably more than the maximum breadth of the maxillary processes. Palatal foramina comparatively long, reaching the level of the anterior roots of m^1. Palate broad, its width between the second molars greater than the width of m^2. Bullæ missing. Mandible light.

Dimensions (of three dried and mounted specimens).—Ear 28-29 mm.; hind foot 41-43 mm.

Skull Dimensions.—Nasals 14.5 × 3.8; interorbital breadth, 5.2; palatilar length 19; palatal foramina 8.5 × 3.5; molar series, upper 7.3, lower 7.5.

Specimens described.—The above description is based on three old and considerably damaged specimens, which are evidently identical with those catalogued by Krefft in 1864, and do not display any noticeable variation. Associated with them is a label inscribed "The White-tipped Tree Rat, *Hapalotis apicalis.*"

Dentition.—Incisors rather slender. Upper molars with their general arrangement as in *conditor* (Pl. v, fig. 1e), but distinctly smaller. Lower molars (Pl. v, fig. 3) :—first lamina of m^1 without a strong outer antero-lateral indentation, its inner cusp not so widely separated from the next as in *conditor;* the other laminæ much as in *conditor* but simpler, their inner and outer cusps not so obliquely placed and the concavities are therefore not so large; there are the same pits behind the second lamina of m^1 and the first of m^2 and m^3; the last is small owing to the thickness of the centre of the lamina; the well-defined, median supplementary cusp behind the posterior lamina of m^1 and m^2 is also present; inner cusps of molar row not as widely separated as in *conditor.*

Comparison with Allies.—Form lighter and teeth smaller than in *conditor* and *jonesi.* The upper surface of the foot is white with only faint suggestions of the dark markings which are present in a greater or lesser degree in *jonesi* and *conditor.* It is readily distinguished from the two latter by its entirely white belly fur, white tail tuft, whiter feet, smaller teeth and generally more delicate form and skull. The skulls of *apicalis* available to me are incomplete, but, according to Waite's figures, the zygomatic arches are wider posteriorly than anteriorly.

The White-tipped Tail.—In a recent paper, Thomas[11] discusses the type of *L. apicalis* Gould, which he states has now an imperfect tail. He further says that Gould "wrongly" described the tail as being white-tipped, and refers to a second specimen from Gould's collection in support of this contention. Gould's descriptions of the species in 1851 and 1863 state definitely that the "apical fourth" of the tail was "thinly clothed with white hairs"; he also mentioned, in comparison with the heavy brush of *C. albipes*, that the tail was "nearly destitute of the long brushy hairs towards the tip," and that he had but a single specimen with those characters. Krefft, who saw numerous living specimens, describing the tail of *apicalis* in 1864, wrote: "It has been stated that the tail of this animal is nearly destitute of the long brushy hairs towards the tip. . . . This, however, is not the rule, but the exception only, though specimens kept in captivity soon lose the long hairs, and frequently their tails also, if kept in company with other rodents." Though Krefft omits colour in his description, the tails were evidently white since he calls the species "The White-tipped *Hapalotis.*" Waite in 1898 described several specimens of *apicalis* from Central Australia and specially noted that Gould's figure was an excellent representation of the animal; he also described a pencil of white hairs at the tip of the tail and suggested that it was probable that the tail of Gould's single example "had been somewhat denuded of hair."

11 Thomas—Ann. Mag. Nat. Hist. (9) viii, 1921, p. 619.

Of three specimens in the Australian Museum only one is complete enough to show the white portion of the tail; though its extreme tip is missing, it has a definite tuft of lengthened white hairs extending around and along the end for about an inch. The tails of the other two are not sufficiently complete to show the tuft. In consideration of the foregoing I cannot accept Thomas' suggestion that the type of *apicalis* was originally other than as described by Gould.

Identification of the Holotype.—Despite the fact that Gould wrote in 1863, twelve years after his original description was published, that he possessed "a single example only of this species," Thomas[12] has referred to two specimens from Gould's collection in the British Museum, one of which he selects as the lectotype of *L. apicalis* (B.M. No. 53. 10. 22. 15). Two months later, however, Thomas[13] definitely states that Gould "seems only to have done his describing from one of them (B.M. No. 53. 10. 22. 14), the worst of the two, young and with an imperfect tail." It is therefore obvious that this latter specimen must be accepted as the holotype of the species.

Habits.—"Nocturnal and gregarious" according to Krefft, who also wrote: "I have frequently taken from eight to ten out of a hollow tree, and tamed them so that they kept about the camp, mounting the supper table at tea time for their share of sugar and damper."

Writing of the "hut-like mounds of dry sticks" constructed by *conditor*, frequently observed by him on the Murray Plains, Krefft noted that "they are either uninhabited or occupied by *Hapalotis apicalis*, a species always at war with the larger, and apparently stronger, but not so numerous *Hapalotis conditor.*"

Localities.—The specimens are labelled as having been obtained on the Lower Murray and Lower Darling Rivers.

Distribution.—Gould's holotype was "procured by Mr. Strange in South Australia." Two specimens were secured at Alice Springs, Central Australia, by Messrs. Gillen and Field, who presented them to Professor Sir Baldwin Spencer. The species once inhabited the "Plains of the Murray and Darling" according to Krefft.

LEPORILLUS JONESI *Thomas.*

(Plate v, figs. 2a-2f.)

Leporillus jonesi Thomas, Ann. Mag. Nat. Hist. (9) viii, 1921, p. 618.

External Characters.—Fur rather thin and poor, not so thick as that of *conditor* or *apicalis;* slate coloured basally both above and below. The general colour of the back, sides and under surface much

[12] Thomas—loc. cit., p. 433.
[13] Thomas—loc. cit., p. 620.

as in *conditor* but darker. On the hands the brown colour-marking is darker and covers much more of them than in *conditor*. The light colour-mark on the surface of the foot (Pl. v, fig. 2b) is more clearly defined and the brown shading is heavier and darker than in *conditor*. Outsides of ears dark brown; upper third of insides covered with yellowish-brown hairs. Tail blackish-brown above, brownish-white below, the colours darker than in *conditor*.

Ear short (Pl. v, fig. 2a), its length slightly less than the distance between the rhinarium and the posterior canthus of the eye; not longer than the distance between the heel tip and the distal end of the first interdigital pad. Tail considerably shorter than the head and body in a spirit specimen; the tail, in two specimens, ends so obtusely as to appear imperfect, but after careful examination, and the removal of the caudal vertebræ, there seems no doubt that they are complete. The tail is more heavily haired than in *conditor*, the scales being almost concealed; the hairs are decidedly longer towards the end, some long ones extending about 14 mm. beyond the tip. Foot broad, its width opposite the distal end of the inner metatarsal pad 9 mm. (Pl. v, fig. 2b); its length from the heel tip to the end of the longest digit 48 mm.; the width 5.3 in the length.

Skull (Pl. v, figs. 2c-d).—Stout and very heavy in the naso-frontal region, the latter accentuated by the considerable thickening of the nasal processes of the premaxillæ; width of the muzzle, at the level of the anterior end of the palatal foramina, 1.2 in the depth, which is shorter than the molar row. Nasals broad and strong, their breadth at the middle of their length, 3.3 in the length. Interorbital region broad, with comparatively sharp angled edges, and with only a small posterior portion of the orbital surfaces of the frontals visible from above. Zygomatic plate broad, its anterior edge curved, concave below, its upper angle projecting forward and broadly rounded. Zygomatic arches expanded anteriorly, the maximum breadth of the maxillary processes greater than the breadth of the arches at the junctions of the processes of the squamosals with the jugals. Palatal foramina short and just reaching the level of the anterior roots of the molars; their length less than that of an upper molar row. Bullæ medium in size, noticeably smaller than those of *conditor* in skulls of the same size, their centres semi-transparent; their depth, measured obliquely from the bony tubercle above the external meatus to the lowest point of the ventral surface, 9 mm. Mandible heavy.

Dentition.—Incisors heavier than in *conditor*, but rather slender for the heavy skull; each more than 1 mm. broad.

The variation displayed by the worn and unworn molars of two specimens is so striking that I have described both conditions, and figured the worn rows of *jonesi* for comparison with the unworn ones of *conditor*, which are typical of the genus.

Comparatively unworn molars of an adult female much as in *conditor* (Pl. v, figs. 1e-f), but somewhat heavier. Upper molars:—antero-internal cusps of m^2 and m^3 situated opposite the divisions and filling the angles between the molars; the cusps pressing closely against the posterior lamina of m^1 and m^2. Lower molars:—first lamina of m^1 with an indentation anteriorly; all other laminæ except the last strongly pinched in at their middles, their inner and outer cusps oblique; posterior lamina of m^1 and m^2 with a well-marked posterior concavity in which is placed a very distinct, rounded median supplementary cusp.

The very worn molars of an aged male, upon which the general description is based, differ markedly from the unworn molars in the following features. Upper molars (Pl. v, fig. 2e) heavier and more rounded; antero-internal cusps of m^2 and m^3 not directed obliquely forward or situated opposite the divisions between the molars, and the cusps not touching the posterior lamina of m^1 and m^2. Lower molars (Pl. v, fig. 2f), heavy and rounded, the laminæ not, or scarcely pinched in at their middles and without the oblique set of the inner and outer cusps. The posterior lamina of m^1 and m^2 are not pinched in at all, and are without any trace of concavities or median supplementary cusps behind, the posterior edges of the laminæ being convex and closely opposed to the laminæ of the succeeding teeth.

Variation.—In a female spirit specimen, 10 mm. shorter than the male described, the ear and tail are of the same length and the foot somewhat lighter, its width being 5.8 in its length, as opposed to 5.3 in the male. In the two spirit specimens the tail is from 30 to 42 mm. shorter than the head and body. The skull of the female is somewhat lighter than that of the male, but heavier than *conditor* in skulls of the same size. Zygomatic arches of the female as wide at the maximum breadth of the maxillary processes as at the junction of the squamosals with the jugals; they are not expanded anteriorly as in the male described. Palatal foramina of the female 1.2 mm. longer than those of the male in skulls of almost equal size. Basal length of upper molar rows 9.5 to 10.5, lower 9.2 to 9.7.

The variation between the molars of the aged male and the adult female is remarkable. In the former the lower molars are so worn that there is not the slightest trace of concavities or median cusps behind m^1 and m^2; they are worn down below the level of the median cusps so that the latter are completely effaced. In the female the concavities and cusps are present in the unworn state. This would seem to indicate that unless a series is available, the presence or absence of such cusps is a character which should be accepted with great reserve.

Dimensions (of spirit specimen).—Head and body 206 mm.; tail 164; hind foot 48; ear, from outer base to tip, 29.

Skull Dimensions.—Greatest length 45.4; breadth of zygomatic arch, at broadest part of zygomatic processes of maxillæ, 23.2; the breadth, at the junction of the jugal with the processes of the squamosals 22; nasals 16.7 × 5; interorbital breadth 5.5; palatilar length 22; palatal foramina 8 × 3.8; breadth of brain-case 17.8; depth of bulla 9; molar series, upper 10.5, lower 9.7.

Specimen described.—An adult male in the Australian Museum collection No. M.3061, presented by Professor F. Wood Jones. The description of the unworn molars is based upon a skull, No. S.1600 also kindly presented by him. A female spirit specimen, lent by Professor Wood Jones, was also examined.

Comparison with Allies.—Form and teeth heavier and the ear smaller than in the other members of the genus. Foot much larger than in *conditor* and with the light mark more clearly defined. In adult skulls of the same length that of *jonesi* is noticeably heavier, but the bullæ are smaller and the palatal foramina are shorter than in *conditor;* the palatal foramina of the former are also shorter than those of a much smaller skull of *apicalis.* The zygomatic arches of *jonesi* are as broad or broader anteriorly, whereas they are broader posteriorly in all my specimens of *conditor* and, according to Waite's figures, in *apicalis.*

Habits.—Professor Wood Jones, to whom the discovery of this species is due, kindly forwarded me some notes upon its habits, but, it being his intention to write upon the species at an early date, I quote but briefly such of the information as is of especial importance in relation to the habits of the other species. The "rats build nests" of sticks which are "often over penguins' holes. Many rats live under and between great granite boulders. Make no burrows of their own."

Localities.—Franklin Island, Nuyts Archipelago, South Australia.

Rattus rattus *Linnaeus.*

Hapalotis arboricola (Macleay) Krefft, in Gould's Mamm. Austr. i, 1863, p. xxxv.

Hapalotis personata Krefft, Proc. Zool. Soc., 1867, p. 318.

Mus novae zelandiae Buller, Trans. N.Z. Inst. iii, 1871, p. 1, pl. i. *Id.* Hutton, *loc. cit.* xi, 1879, p. 344.

Mus griseocaeruleus Higgins and Petterd, Proc. Roy. Soc., Tasm., 1882 (1883), p. 173, fig. 2-2a, and 1883 (1884), p. 197. *Id.* Longman, Mem. Qld. Mus. v, 1916, p. 34.

Mus variabilis Higgins and Petterd, Proc. Roy. Soc., Tasm., 1882 (1883), p. 174, fig. 3-3a. *Id.* McCulloch, Rec. Austr. Mus. vi, 4, 1907, p. 312.

Mus tamarensis Higgins and Petterd, Proc. Roy. Soc. Tasm., 1883 (1884), p. 185. *Id.* Longman, Mem. Qld. Mus. v, 1916, p. 34.

Mus (*Hapalotis*) *tompsoni* Ramsay, Proc. Linn. Soc. N.S. Wales, vi, 4, 1882, p. 763, figs 1-3. *Id.* McCulloch, Rec. Austr. Mus. vi, 4, 1907, p. 312.

Conilurus personatus Ogilby, Cat. Austr. Mamm., 1892, p. 118.

Mus rattus rufescens Collet, Proc. Zool. Soc., 1897, p. 323.

Mus arboricola Waite, Proc. Zool. Soc., 1897, p. 857-860 (with note by Thomas).

At the time Krefft described *Hapalotis personata* it was apparently not realised that *R. rattus* was established in Australia. The first authentic record of its occurrence was probably the published description of *H. arboricola* Macleay in 1863, though the identity of that species with *rattus* was not determined until 1897. It is surprising that writers, dealing with rats taken in localities and conditions typical of those affected by *rattus*, should have described so many synonyms of the species and even allocated them to different genera. While the status of these synonyms remained in doubt they formed a considerable obstacle to any work on allied species; it is therefore with satisfaction that I definitely relegate another of these doubtful species to its correct place in the Australasian synonymy assembled above.

H. personata Krefft, has not been recognised since it was first described, and, though Mr. Oldfield Thomas' remarkable knowledge of the Murinæ enabled him to suggest that it "probably belongs to *Mus*," [14] its affinities and status have remained unknown. The type and two other mounted specimens are in the collection of the Australian Museum, and an examination of their crania and external characters proves *personata* to be synonymous with *rattus*.

In describing *personata*, Krefft, evidently referring to the complete laminæ and also the cusps as "tubercles," wrote: "In the upper jaw the first tooth has three tubercles of almost equal size, the second also three (the inner one very small), and the third two (the inner less than half the size of the outer one)." In the absence of a specimen this might suggest that the teeth were of the *Mesembriomys* type, but the posterior lamina of m^1 and m^2 do not extend across to form a third postero-internal cusp to these teeth. The "second tooth" has two laminæ, the "inner tubercle" of Krefft being the antero-internal cusp of m^2; the tooth was regarded by the author as having three tubercles. In the lower molar row, the author's fourth and third tubercles of m^1 and m^2 respectively, are the median supplementary cusps which are typical of these teeth in *rattus*, with which species the dentition agrees in every essential.

[14] Thomas—Ann. Mag. Nat. Hist. (7), xvii, 1906, p. 84.

The body and tail measurements given by Krefft agree approximately with those of the mounted specimens, from which they were doubtless taken; the head and body of these specimens are considerably stretched, which evidently accounts for Krefft's statement that they are longer than the tail. The specimens are old and their fur very much thinned, so that the dark mark from the nose to the eye described by Krefft is not discernible; it is possible that it was part of the dark colouring of the upper surface, the edge of the lighter colour of the under surface running just below the eye in the mounted specimens.

In deciding the affinities of this long lost species, the interesting fact has emerged that *rattus* had established itself at Cape York, apparently in the bush, as early as 1867.

The type of *personata* is registered no. 75, and two other specimens nos. 76-7, in Secretary Palmer's register of the early Australian Museum collection.

I have included *R. rattus rufescens* Collett in the above synonymy as the measurements quoted by him are typical of Australian specimens of *rattus*. I have collected specimens of the blackish-gray and others of the *rufescens* type of colouration within a few yards of each other; they were of similar length, the head and body of each being about 7 ins. long.

Habits and distribution.—Since the first records of its appearance in Australia, this ubiquitous old world species has spread amazingly, reaching the remoter parts of the country and periodically occurring as plagues and doing grievous damage. It has also been associated with two serious outbreaks of bubonic plague. The writer has trapped it in the bush at Eyre's Peninsula, and between Albany and Denmark in south Western Australia. In the latter locality, where *Rattus fuscipes* was once plentiful, my traps were recently repeatedly filled with *R. rattus*.

Several years ago *rattus* was accidentally introduced to Lord Howe Island, where its variability in colour caused residents to believe that more than one species was represented. On the island many of the rats have adopted the same mode of life as attributed to "*arboricola*," building nests in vines and tree spouts, and eating fruit, vegetables, and molluscs; one of the nests was in a spout about sixteen feet from the ground, the opening of which was filled with layers of fresh leaves, the nest apparently communicating with the hollow centre of the tree. The rats, having increased with characteristic rapidity, now overrun the island and seriously menace the local seeding industry; they climb to, and travel with ease, amongst the close growing palm tops, eating an amazing quantity of the valuable Kentia Palm seeds. They also eat the eggs and young of insectivorous birds, which they have so nearly exterminated that the insect fauna has greatly increased. The rats also eat household stores, corn, potatoes,

fruits, and the roots of rare and interesting plants. As noted of "*arboricola*," they are very partial to snails, and the gnawed shells of *Placostylus bivaricosus* may be seen all over the island and taken from the nests of rats. The living snails, which were once very plentiful, are now quite scarce, possibly because they supply moisture as well as food for the rats in dry seasons.

Boulenger[15] has noted that *R. Rattus* and *norvegicus* are now often found living in harmony together, and I recently received specimens of both species taken from the same house at Neutral Bay, Sydney.

[15] Boulenger—Proc. Zool. Soc., 1919 (1920), p. 244.

A NEW GENUS OF ELAPINE SNAKE FROM NORTH AUSTRALIA.

By

J. R. Kinghorn, Zoologist, Australian Museum.

(Plate vii and Figures 1-3.)

Through the generosity of Mr. H. L. White, of Belltrees, Scone, New South Wales, and the energies of his collector, Mr. W. McLennan, the Australian Museum acquired the large Elapine snake which is described below as belonging to a new genus.

Family COLUBRIDAE.

Subfamily ELAPINAE.

Genus Oxyuranus, *gen. nov.*

Maxillary extending forwards beyond the palatine, with one or two pairs of large grooved fangs followed by one small grooved tooth near the posterior extremity. Anterior portion of the palatine toothless and prolonged into a needle-like projection, the point of which is well behind the level of the anterior portion of the maxillaries. The palatine bears five to six and the pterygoid eight to nine small teeth. The maxillary teeth gradually decrease in size posteriorly, the anterior pair are much the largest, and the first two or three pairs on either side are feebly grooved.

Head not, or but slightly, distinct from neck; nostril situated in a divided nasal; no loreal. Body cylindrical; scales smooth[1]; ventrals rounded; subcaudals in two rows.

Oxyuranus maclennani *sp. nov.*

Eye longer than high, its vertical diameter less than its distance from the mouth. Head not, or but slightly, distinct from the neck. Rostral broader than deep, visible from above. Internasals broader than long, shorter than, and not half the size of the prefrontals. These latter are broader than long and form sutures with the internasals, posterior nasal, second upper labial, preocular supraocular, and frontal. Frontal about twice as long as broad, once and one-third as broad as the supraoculars; its length equal to its distance from the posterior border of the rostral, and shorter than the suture formed by the parietals. Nasal divided, narrowly separated from the preocular by its suture with the prefrontal. Two postoculars; temporals 2 + 3.

[1] A few of the central rows of dorsal scales appear to bear obtuse keels, but, as the skin is a flat one and was dried after being painted with an arsenical soap, these keels may be due to shrinkage. Mr. McLennan tells me that he is almost certain that the scales were smooth on the living snake.

the lower anterior wedged in between the fifth and sixth upper labials.[2] Six upper labials, the third and fourth entering the eye. Seven lower labials, the first three being in contact with the anterior chin shields, which are longer and broader than the posterior. Scales in 21 rows round the centre of the body, more on the neck. Anal single. Subcaudals in 67 pairs. Ventrals 234.

Colour (from life).—Dark brown above, with a golden sheen; under parts pale cream, as also are the labial regions.

Total length of holotype (skin containing skull), 2,760 mm.; tail, 375 mm.; head, 80 mm. Paratype, skull only, belonging to a specimen which measured 2,545 mm. in life.

Locality.—Coen, Cape York Peninsula, North Queensland.

Holotype (registered no. R.7901) and paratype (registered no. R.7900) in the Australian Museum.

AFFINITIES.

External characters.—Examination of the external characters alone would allow this snake to be most nearly allied to *Pseudechis scutellatus* Peters[3], which species I at first thought it to be, but the dental and cranial characters are so very different from those of any other elapine snake, that the only course left open was to describe it as a new genus.

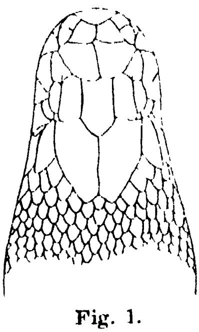

Fig. 1.

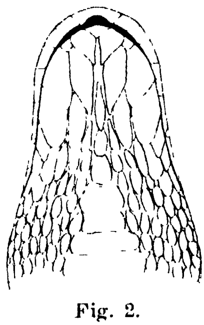

Fig. 2.

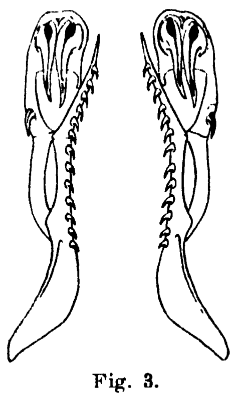

Fig. 3.

Fig. 1. Dorsal view of head, showing size and arrangement of shields. ½ natural size. R. 7901.
" 2. Lower labials and thin shields. ½ natural size. R. 7901.
" 3. Palatines and maxillary bones. Natural size. R. 7900.

[2] In the type the lower anterior temporal on the left side of the head is abnormal, being divided into two, and it is separated from the postocular by the upper portion of the fifth upper labial, which forms a suture with the upper anterior temporal.

[3] In referring to Peters' original description of *Pseudechis scutellatus* (Monatsb. K. Akad. Wiss., Berlin, 1867, p. 710), I noticed that he states that his type has forty-eight pairs of subcaudals, whereas Boulenger (B.M.C. Snakes, III, p. 1896, p. 331) says "subcaudals 61-78 pairs."

COMPARATIVE.

The Maxillary.—The maxillary bone extends well beyond the anterior extremity of the palatine, while in all other Australian elapine snakes, with the exception of *Furina,* the palatine is either on the same level as, or in advance of, the maxillary. As the genus *Furina* is very distinct through the absence of the post frontal and through the pre-frontals extending backwards so as to almost form a suture with the parietals, thereby almost excluding the frontals from the orbital periphery, it need not be seriously considered.

Fangs and Maxillary teeth.—The fangs are exceptionally large, notwithstanding the fact that the examples belong to snakes which measure nine feet three inches and eight feet six inches respectively. There are several pairs of reserve fangs situated in the gums. On the posterior end of the maxillary bone there is only one small grooved tooth which is active, though there are three reserve teeth, one lying in the reserve pocket. The only other Australian snake which may possess but one tooth following the fang is *Acanthophis.* This genus, which is viperine in form and possesses a strong outer process on the ectopterygoid, is so very distinct that further comparisons need not be made.

Palatine and Pterygoid.—The palatine possesses a long, toothless, needle-like anterior process, which projects well beyond the teeth, but not to the level of the anterior extremity of the maxillary bone. Such a process is not traceable to any other elapine snake examined. The palatine and pterygoid teeth total only thirteen to fifteen, and the anterior pair do not reach to the level of the posterior base of the fangs, while the posterior pair are situated almost on the same level as the posterior border of the transverse bone. Speaking generally there are fewer palatine and pterygoid teeth in *Oxyuranus* than in any other Australian elapine genus, and they do not extend so far forward or backward on their respective bones.

Mandibular teeth.—The mandibular teeth number twelve to fourteen. The anterior pair are the largest, the remainder decreasing gradually in size posteriorly, while the first two or three pairs are feebly grooved. In other Australian elapine snakes the third pair of mandibular teeth are generally the largest, the anterior never.

The Frontals.—The frontals are nearly twice as broad as long. Their posterior borders stretch out beyond the anterior border of the parietal and form a notch on each side.

The Parietal.—This bone is, comparatively, much narrower anteriorly than that of any other snake examined. The antero-lateral process, which forms a suture with the post frontal, is very poorly developed and does not extend outwards, but, on the contrary, forms a very obtuse angle with the lateral edge of the frontal. So that the orbital periphery may not suffer enlargement by this cutting away, the post frontal is strongly developed, somewhat triangular in shape,

and its upper anterior edge fits into the notch formed by the extension of the frontals beyond the parietal. In other species examined there is a strong, outward, anterior process on the antero-lateral edge of the parietal, while the postorbitals are very weak and slender.

The horizontal plate is triangular and exceptionally small, while from it to the posterior border of the parietal is a strongly developed median ridge. In other species examined this plate is much larger, often extending the whole length of the parietal, while the ridge, when present, is generally flat and obtuse. The only allied genus in which I can find a distinct ridge is *Demansia*, but in that genus it is very small.

Summary.—Oxyuranus differs consistently from all allied genera by the extension of the maxillary beyond the palatine; by the peculiar anterior process on the palatine; the narrow anterior portion of the parietal; the strongly developed postfrontals; the fewer palatine and pterygoid teeth and the enlarged anterior mandibular tooth.

Field Notes.—Mr. McLennan rode over the top of this snake in the long grass near Coen, Queensland, taking it, at a glance, to be one of the large pythons. The snake moved off rapidly when attacked, but was despatched by two blows from a sapling. When measured before skinning it was found to be nine feet three inches in length, and eight inches in girth, and Mr. McLennan recorded it as the largest of its kind that he had ever seen. He noted that there was only one tooth following the poison fang on the right side and two on the left side, but, when I examined it, I found that the second tooth was merely in reserve and was not firmly attached to the bone. Venom was collected, but unfortunately the tubes were corked up before the venom was dry, and I am afraid that it has fermented; nevertheless, it has been sent to an experimentalist to be tested. When opened the snake was found to contain the remains of a *Dasyurus*.

NOTES ON SOME AUSTRALIAN CASSIS.

By

CHARLES HEDLEY.

(Plate viii.)

On their recent visit to Western Australia the Museum representatives received from Mr. J. Stow a specimen of *Cassis bicarinata* from Middle Island, Recherche Archipelago. Mr. A. S. Faulkner kindly presented a specimen of *Cassis fimbriata* from King George Sound. This localised and contrasted material, supported by other in the Museum collection, indicate that *C. bicarinata*, instead of being regarded as synonymous with *C. fimbriata* as it usually is, should be held apart.

The history of *C. fimbriata* is rather obscure. Doctors Quoy and Gaimard forgot the locality of the two specimens they had collected during the voyage of the "Astrolabe," but supposed that it was either the Marianne or the Caroline Group.[1]

They remarked that specimens labelled "frangé" were already in the Paris Museum from the expedition commanded by Capt. Baudin. Baudin's ships visited the area inhabited by *C. bicarinata*, but the "Astrolabe" did not do so. Specimens before me from Albany, Western Australia (a collecting station of both French expeditions) correspond closely to the "Astrolabe" figures, and indicate that Western Australia, and not the Carolines or the Mariannes, is the home of *C. fimbriata*. Regarding as typical the shells that match the drawings, an immature stage of a length of 60 mm. has four and a half whorls plus the protoconch. Between the last two varices and along the angle of the shoulder is a row of fourteen projections set like the teeth of a cog wheel. Anterior to this is a second row with the tubercles fewer and farther apart; these are not united in a common base, as in the figure. As shown in profile by the "Astrolabe" figure,[2] there is a third row, of incipient tubercles arranged at a distance equal to the space between the other rows. The whole dorsal surface is plicated by about thirty-five longitudinal folds. On the anterior half of the last and on the summits of all whorls, these folds are traversed by fine spiral grooves. A narrow broken thread of amber-brown runs along the summit of each row of tubercles, two such run between the rows, and three or four on the anterior region. The ventral surface is overlaid by a dense sheet of callus, through which appear the brown spirals of the previous whorl. At the exterior base of the columella are from three to five short transverse ridges. The

[1] Quoy et Gaimard—Voy. Astrolabe Zool. ii, 1833, p. 596, pl. xliii, fig. 7, 8. Kuster, Conch. Cab., 1857, p. 28, pl. xlvii, figs. 1-2. Hidalgo (Cat. Moll. Test Filip. and Marianas, 1905, p. 156) definitely rejects the Marianne habitat.

[2] Quoy et Gaimard—loc. cit., pl. xliii, fig. 7.

inner lip is smooth. The proportion of length to breadth given in the text agrees neither with their figure nor with my specimens. Such immature shells as described here lead to adults of five and a half whorls, plus protoconch, in a length of 83 mm. In the mature shells both the lip and columella carry a few weak folds.

The original locality given by Jonas for his *Cassis bicarinata* was China, but his excellent illustration enables the reader to accurately identify his species as Australian. Though a thinner and lighter shell, *C. bicarinata* attains the larger size, a specimen from Lacépède Bay reaching a length of 125 mm., thus exceeding *C. fimbriata* by a third; the shoulder tubercles of *C. bicarinata* are more subdued than those of *C. fimbriata*, and the spirals which persist on the summits of all whorls in *C. fimbriata* are restricted to the earlier whorls of *C. bicarinata*. The irregular colour stripes of *C. bicarinata* are walnut brown, but those of *C. fimbriata* are ochraceous-orange. The callus on the body whorl of *C. bicarinata* is reduced to a mere glaze.

By these identifications, *C. fimbriata* ranges from King George Sound (A. U. Henn and A. S. Faulkner) west and north to Vansittart Bay (Capt. W. Burrows), while *C. bicarinata* extends east from the Recherche Archipelago (W. J. Stow) to Lacépède Bay, Kangaroo Island (Australian Museum Collection), and St. Vincent Gulf (Angas) to Portland, Victoria (Pritchard and Gatliff).

A smaller, closely wrinkled, low spired form, figured by Kiener, appears to be the Kangaroo Island variety. For this, in reference to the habitat, I now propose the varietal name of *Cassis bicarinata* var. *decresensis*.

The references to *C. fimbriata*, as now restricted, are those already quoted in the preceding footnote. Literary references to *C. bicarinata* are as follows:—

Cassis bicarinata Jonas, Archiv. Naturg., 1839 (1), p. 343, pl. x, fig. 2. *Cassis fimbriata* Kiener, Coq. viv, 1835, p. 12, pl. iv, fig. 6. *Id.*, Reeve, Conch. Icon., v, 1848, pl. vii, fig. 17. *Id.*, Angas, Proc. Zool. Soc., 1865, p. 168. *Id.*, Verco, Trans. Roy. Soc. S.A., xxxvi, 1912, p. 216.

CASSIS RUMPFII, *Gmelin.*

This species has an intricate synonymy and a vague claim to be included in the Australian fauna. Deshayes, who examined the nomenclature, advocated the use of *Buccinum spinosum* of Gronovius as dating from 1781, but modern writers have discarded that author as non-binomial. In order of seniority the next name is *Buccinum fasciatum* of Bruguière, 1789, but this was preoccupied by O. F. Müller in 1774. Next Gmelin named it in 1791, first *Buccinum tessellatum*, then *Buccinum maculosum*, and thirdly *Buccinum rumpfii*. The first two of these names were preoccupied by Martyn, but the third, based on Rumphius, pl. 25, fig. 3, is legitimate. Afterwards the shell was called *Cassis coronata* by Bolten in 1798.

Following Martini, Lamarck in 1822 referred the species to the South Seas. But in the Geneva Museum I observed that his three specimens, which were possibly from Baudin's expedition, are now labelled "Australie." Reeve in 1848 seems to have been the first to publish Australia as a habitat. I have seen several specimens in museums labelled "Australia," but never with collector's name or precise locality. I have no good evidence that *Cassis rumpfii* crosses the Equator, but it is possible that it may extend from the Moluccas to North West Australia.

NOTES ON AUSTRALIAN DECAPODA.

By

ALLAN R. McCULLOCH and FRANK A. McNEILL, Zoologists,
Australian Museum.

(Plates ix-xi and Figures 1-2.)

Family OCYPODIDAE.

Subfamily SCOPIMERINAE.

Genus SCOPIMERA *De Haan.*

SCOPIMERA INFLATA *A. M. Edwards.*

(Plate ix, figs. 1-2, Plate x, figs. 1-2, Plate xi, and Fig. 1.)

Scopimera inflata Kemp, Rec. Indian Mus., xvi, 5, no. 22, 1919, p. 321.

Although no species of *Scopimera* has been hitherto recognised from the Australian coasts, *S. inflata* is very common on many Queensland beaches, and extends as far southward as Port Jackson, New South Wales. It was first observed by one of us on a coastal beach near Cooktown, North Queensland, and later at Port Stephens, New South Wales. We have it also from Ballina and Trial Bay, New South Wales, and a few small examples were collected on a sheltered beach in Port Jackson.

Habits.—*Scopimera inflata* is rarely found on any but coastal beaches where the sea water is clear and free from mud. The inner harbour beaches on which it occurs are always formed of clean sand, and are in the vicinity of strong currents. It is commonly found near small streams of fresh water which cross the beaches, and its burrows are sometimes found in sand which is kept moist by the soakage of brackish water. But, unlike its allies of the genus *Ocypode*, *Scopimera* is unable to withstand any buffeting by the surf. It prefers flat and sheltered positions of the coastal beaches where the waves are small (Plate x, fig. 1), and where the rise and fall of the tide leaves the sand undisturbed.

In such favourable localities large areas of flat sand several hundred square yards in extent may be seen to be covered with millions of tiny pellets, which, often being above the reach of neap tides, may remain for days together until they are disintegrated by a flowing spring tide.

At the southern end of Fingal Bay, near Port Stephens, these pellets were observed to be very plentiful in September, 1918 and 1919. They are rounded and of uniform size, and roughly arranged in irregular lines, nine to eighteen inches long, radiating from the mouth of the burrow, while larger irregularly shaped pellets excavated from the burrow are scattered among them.

Burrowing is perhaps usually carried out as the tide recedes and while the sand is quite soft and easily moved. The large pellets are excavated and carried up to the mouth of the burrow by the crab, and deposited irregularly near its opening. Some burrows we examined were twelve to fifteen inches deep (Plate x, fig. 2), and penetrated through the firm dry sand to the level of the water, where the sand was very moist and soft. The crab feeds on the surface of the beach in the glaring sun, and is apparently in no way incommoded by the direct rays falling upon its upraised and staring glassy eyes. Likewise, the heavy contrast met with in coming out onto the sunny beach from the dark cool depths of its burrow, seems in no way to effect its excellent vision. It is extremely shy and fleet, and retires to the depths of its burrow upon the least alarm. A wind blown leaf or a butterfly flying overhead is sufficient to scare all the crabs from the beach in its neighbourhood. This perhaps accounts for the shortness of the food trenches, the crabs being too shy to venture far afield from their safe retreat. The crab can be observed feeding only when perfect quiet is maintained, and the slightest indication of one's presence keeps it watchfully at the entrance to the mouth of its burrow. When feeding, the crab moves sideways from its burrow and scoops out a narrow trench with its chelipeds (Plate xi, fig. 1). The excavated sand is passed into the lower portion of the capacious mouth-jaws, where it is sieved for its contained food particles. It is then expelled from their upper portion, and so manipulated as to form a rounded pellet. Upon reaching a definite size, the pellet is passed backwards and deposited on the beach behind the crab, which simultaneously moves on a pace outwards from its burrow; as the trenches are approximately straight, it follows that the pellets are arranged in irregular rows behind them (Plate xi, fig. 2). Some were observed to feed so rapidly that a fresh pellet was produced about every fifteen seconds.

The size of the pellets corresponds with that of the crab that makes them, those of young specimens being much smaller than the pellets of adults.

Identity.—Specimens forwarded to Miss M. J. Rathbun were identified for us as *Scopimera inflata* A. M. Edw.[1] This species has been recently redescribed by Kemp (*loc. cit.*) from a badly damaged adult female specimen which he believes to be one of the original examples determined by A. M. Edwards, and which were rather vaguely localised ("Habite la mer des Indes"). We submitted other

[1] Journ. Mus. Godeffroy i, 4, 1873-74, p. 259 (83).

specimens to him for comparison with it, and in reply he has generously forwarded us the following taxonomic notes, together with the two small text figures which appear in the following pages.

"In my opinion all the specimens are correctly identified as *Scopimera inflata* A. Milne-Edwards. I have compared them with the female in the Indian Museum, on which I published some notes in 1919 (*loc. cit.*), and find that, so far as can be judged from the imperfect condition of that specimen, the agreement is exact. Our female is without definite locality, and, as I have pointed out, almost certainly came from the Godeffroy Museum; it is no doubt part of the material determined by A. Milne-Edwards and, inasmuch as other authentic specimens seem no longer to exist, may conveniently be regarded as a co-type. The specimen is in poor condition and, apart from the loss of several limbs, is much macerated. I noted in 1919 that the upper surface of the carapace appeared to be without evident sculpture, but on re-examining it in comparison with the Australian material I have been able to detect a pattern of fine grooves. This pattern is in precise agreement with that seen in the Australian specimens and does not differ greatly from that described by Roux in *S. kochi*. The strong tubercles found in specimens from New South Wales on the lateral and anterior parts of the carapace are practically indistinguishable in our specimen, but their disappearance is no doubt due to maceration. For the same reason the merus and ischium of the outer maxilliped appear smooth, whereas they are obscurely tuberculate in well-preserved individuals. The legs that exist agree most closely with those of Australian females, and large males from Australia possess the tooth on the inner side of the carpus of the cheliped which was noticed by A. Milne-Edwards in his original description.

"The three specimens from Cooktown in Queensland are not specifically distinguishable from those found in New South Wales. They are, however, considerably smaller, due no doubt to a less favourable environment, and the grooves of the carapace are less distinct.

"The rediscovery of *Scopimera inflata* is a matter of considerable interest, and the fresh material now examined shows that some emendation is necessary in the characters which I gave in 1919 (*loc. cit.*, p. 311) for the separation of the species from *S. kochi* Roux and *S. sigillorum* (Rathbun).

"[*Affinities.*—]*Scopimera inflata* differs from Roux's detailed description[2] of *S. kochi*, a species found at Merauke in New Guinea, in the following particulars:—

(i) The lateral margins of the front are raised and almost smooth, with the median portion much sunken and bearing an obscurely tuberculate ⊥-shaped elevation. In *S. kochi* the edge of the front is described as finely granular, and in the middle there is a swollen area bearing a longitudinal carina.

[2] Roux, in Nova Guinea, v, Zool., 1917, p. 610, pl. xxvii, figs. 21-24.

(ii) The mesogastric region is not concave.

(iii) The fine grooves in the middle of the carapace form a pattern similar to that found in *S. kochi*, but the median limb of the M-figure is suppressed, the grooves of either side not quite meeting in the middle line. The lateral stroke of the M curves outwards and forwards as in the allied species. In the specimens examined the grooves show some variation; their development in two individuals is shown in Figure 1.

Fig. 1.

Showing variation of the carapace grooves as exhibited by two individuals of *Scopimera inflata*.

(iv) There is a granulate line above the base of the last leg and at the inner end of this line a crescentic depression. These features are not mentioned by Roux.

(v) The outer maxilliped is similar to that of *S. kochi*, but the merus is more angulate antero-internally, a blunt ridge (not shown in the figure I gave in 1919) extends downwards from the carpal articulation for nearly half the length of the segment, and the granules which may be seen in large specimens on this segment and on the ischium are small and obscure, differing widely from the large tubercles of the allied species.

(vi) The inner margin of the carpus of the chelipeds is conspicuously angulate in well-grown females,[3] and in the male bears a stout tooth. In *S. kochi* this margin is evenly rounded.

(vii) At the base of the mobile finger there is in adult males a large rounded tooth with a serrate edge, in females a low serrate elevation.

(viii) The walking legs appear to resemble those of *S. kochi* very closely; Roux has not stated that tympana occur on both sides of the merus, but it is unlikely that his species differs in this respect.

(ix) In the abdomen of the male the antero-lateral projections of the fourth segment are less acute than in Roux's figure, the suture between the fourth and fifth is strongly curved, and the fifth segment is rather more constricted basally.

[3] This statement is correct to a certain degree. An examination of very large female specimens (12 mm. wide) in the collection of the Australian Museum, however, has proved that these examples, while not possessing a spine equal to that of males of the same size, nevertheless bear a structure on the area in question, which is quite as acute and which could not be termed angulate.

"Other valuable characters could no doubt be found on actual comparison of specimens, but *S. kochi* seems to be readily distinguished by the absence of a tooth or angulation on the inner border of the carpus of the cheliped. *S. inflata* appears to be the larger of the two species; in the largest male examined the breadth of the carapace between the antero-lateral angles is 10.5 mm.

"*Scopimera sigillorum* (Rathbun)[4], described from a single female found at Sandakan Bay, Borneo, is extremely closely related to *S. inflata,* and it is not impossible that the two are synonymous. Miss Rathbun's remark that 'a broad furrow on the front is continued across the gastric region' does not, however, apply well to the specimens I have seen and she does not make any mention of the tympanum, traversed by a narrow longitudinal ridge, on the inner face of the merus of the cheliped. This important character is found in both *S. kochi* and *S. inflata*, but not in any other species of the genus, though a similarly divided tympanum is found in the walking legs of *S. investigatoris* Alcock and *S. proxima* Kemp. The carpus of the cheliped is said to have the 'inner angle rounded'; in all other respects the description agrees very closely with Australian specimens of *S. inflata.*"

While considering the foregoing valuable notes, it is appropriate to point out here that Miss Rathbun, on comparing a similar series of *S. inflata* to that examined by Kemp, with the female holotype of *S. sigllorum*, considered the latter a distinct species nearest to *S. inflata*. She writes that on comparing females of the two species it was found that the shape of the body and legs was similar. But goes on to state that "In *S. sigillorum* the carapace is nearly devoid of granules; only a short line of granules behind the basal half of the eyestalk and nearly parallel to the orbital margin, and a border of granules on an angular projection above and behind the antero-lateral angle of the carapace." Further, she considers that *S. inflata* "has the antero-lateral angle a little more prominent laterally. Rostrum wider. Ischium of maxilliped longer in proportion to the merus" (a difference referred to by Kemp in 1919, *loc. cit.* p. 324). Finally, "*S. sigillorum* has no tooth at the inner angle of the wrist" or carpus, a character which we find in *S. inflata* as noted by Kemp in a previous paragraph.

Conclusions.—In view of the fact that Miss Rathbun had the added advantage of being able to compare specimens of both species, it would appear to us that the two should be considered distinct, unless variation in further specimens of *S. sigillorum* should prove it to be synonymous with *S. inflata,* as suggested by Kemp in this paper.

We are indebted to Mr. H. Furst for the excellent photographs which illustrate the paper. He not only devoted considerable time and trouble to securing those illustrating the sand pellets, but also

[4] Rathbun—Proc. U.S. Nat. Mus. xlvii, 1914, p. 82.

opened up a burrow so carefully that he was able to take a splendid picture of its interior. To Mr. J. R. Kinghorn our thanks are due for the figure of the crab, which is prepared from a male specimen measuring 9 mm. between the antero-lateral angles of the carapace, and 7 mm. from the rostrum to the posterior margin of the carapace.

Localities.—Near Cooktown, North Queensland; collected by A. R. McCulloch, 1918. Finches Bay, near Cooktown, North Queensland; collected by A. R. McCulloch, 1918. Ballina, New South Wales; collected by R. Etheridge, Junr., 1893. Trial Bay, New South Wales, on lagoon sand flats, about quarter of a mile from ocean; collected by J. R. and A. Kinghorn, January, 1920, and January, 1921. Fingal Bay, near Port Stephens, New South Wales; collected by A. R. McCulloch, 1918, and September, 1919. Roslyn Gardens, Middle Harbour, Port Jackson, New South Wales; collected by A. R. McCulloch, October, 1919.

Family GRAPSIDAE.

Subfamily GRAPSINAE.

Genus METOPOGRAPSUS *Milne Edwards.*

METOPOGRAPSUS LATIFRONS (*White*).

Grapsus latifrons White, Jukes, Voyage "Fly," ii, 1847, p. 337, pl. ii, fig. 2.

Metopograpsus latifrons Kingsley, Proc. Acad. Nat. Sci. Philad., 1880, pp. 190, 191.

A male and female of this species, which has not hitherto been recorded from Australia, have been compared with the figures and descriptions referred to above, and prove to be similar in every respect. They were collected by one of us in June, 1918, when they were observed crawling about on the roots of mangroves well above the water-line. They did not retire to the water when approached, but doubled and dodged around the branches, rendering their capture difficult. Their brilliant violet colouration, particularly of the hands, made them very conspicuous.

Locality.—On mud-flat mangroves, Endeavour River estuary at Cooktown, North Queensland; collected by A. R. McCulloch, 1918.

Family PILUMNIDAE.

Genus CARPILIUS *Leach.*

CARPILIUS MACULATUS (*Linnaeus*).

Carpilius maculatus Alcock, Journ. Asiat. Soc. Bengal lxvii, pt. ii, No. 1, 1898, p. 79 (and synonymy). *Id.* Pesta, Denkschr. k. Akad. Wiss., Wien, math.-naturw. Kl. lxxxviii, 1913, p. 39, Taf. iii, fig. 4.

A large carapace of this species (135 mm. wide), together with a major chela from a somewhat smaller specimen, have recently been received from Queensland. These specimens have been carefully compared with the figures referred to above, with which they agree in all structural details. The distribution of the red colour spots on the carapace is the same as that described by Alcock (*loc. cit.*).

No previous record of the occurrence of the species in Australian waters appears to have been published.

Locality.—Washed up on reef at Holbourne Island, off Port Denison, Queensland; collected by E. H. Rainford, 1921.

Family ATYIDAE.

Genus ATYA *Leach.*

Species of this genus are known from the West Indies, Africa, Indo-Malaysia and the Pacific Islands, but none appears to have been hitherto recognised from Australia.

ATYA STRIOLATA, *sp. nov.*

(Plate ix, figs. 3-4, and Plate x, fig. 3.)

Rostrum not quite reaching the middle of the second joint of the antennular peduncle, acute, sharply keeled above and with five teeth below; a lateral carina commences near the tip on each side and runs without interruption into the orbital margin. Lower orbital angle forming a flattened projecting spine; no branchiostegal spine. Carapace smooth, with a very faintly impressed line defining the branchial area; pleon smooth, the lower margins of the posterior pleura with a fringe of hairs. Telson rather flat above, with a row of seven movable spinules on each side of the median line, commencing about the middle of its length and terminating on its posterior margin; the latter bears a short fixed spinule on the median line and a long movable spine inside each outer angle; an upper row of short bristles and a lower row of much longer ones. A strong flattened spine on the lower surface of the telson between the bases of the uropods.

A long and slender spine projects forward from the outer side of the first joint of the antennular peduncle; the third joint of the peduncle attains the level of the external spine of the scaphocerite. Twenty-two to twenty-four of the basal joints of the external flagellum are much thickened, after which it becomes abruptly narrower. The outer inferior angle of the peduncle of the scaphocerite is produced into a sharp spine, and a second stronger spine arms the outer margin of the scaphocerite; antennal peduncle reaching a little beyond the middle of the second joint of the antennular peduncle.

First and second pairs of periopods similar in structure, but the latter are a little longer than the former; both are unarmed, and the tips of their setæ reach beyond the spine of the scaphocerite. Third, fourth and fifth periopods decreasing in size backwards. The merus of the third pair is armed with four minute spinules on its upper margin, and several more overhang its upper distal border; three larger spines form a row on its postero-inferior surface, and five stout spinules form a crest on the distal portion of its interno-inferior margin. Carpus with several rows of small spinules on all its surfaces, and a larger spine on its postero-inferior surface. Propodus covered with rows of small spinules which are most crowded on its lower surface. Dactylus short and broad basally, with a long terminal spine and some short strong ones on its lower edge. The fourth periopod is similar to the third but less spinate and without the inner crest of spines on the merus. Merus and carpus of the fifth periopod similar to those of the fourth though still less spinate; the propodus is similarly spiny, but has an additional larger spine projecting from the distal postero-inferior angle; the dactylus has only a terminal spine and a comb of closely set spinules on its postero-inferior border.

First pair of pleopods smallest, the third largest; all are unarmed. Posterior angle of the peduncle of each uropod forming a flat spine; each outer uropod with an oblique row of spines at the junction of its hard and soft portions.

Colour.—Green in life, closely speckled with microscopic blackish-brown dots. A broad, light yellowish, median band extends from the tip of the rostrum to the end of the telson, which is closely speckled and sharply defined by blackish borders. Five narrow longitudinal stripes along each side of the carapace, some of which are more or less interrupted; these are light in colour without darker speckles, and have dark margins. Two similar stripes along each side of the abdomen. Uropods pale green basally, changing to light blue terminally; the outer with a light distal spot with an ill-defined darker border, the inner with a similar but less distinct spot. Antennular peduncles with a light stripe on the upper surface, the remainder green. Limbs and antennæ translucent green; pencils of the fingers darker at the bases and tips.

Described and figured from an adult specimen, 44 mm. long from the tip of the rostrum to the end of the telson. It has unfortunately lost the third to fifth periopods, which have been described and figured from a somewhat smaller specimen taken with the holotype.

Variation.—A series of thirty-nine specimens 22-51 mm. long, does not exhibit any striking variation such as has been described in other species of the genus. The form and armature of the appendages appear to be very simliar in all; the rostrum is rather more slender and longer in some large ovigerous females than in the specimens described. All exhibited the same colour-marking in life, though the smaller examples were lighter than the larger ones.

Occurrence.—We are indebted to our friends Mr. J. R. Kinghorn, Mr. E. Troughton, and Mr. A. Musgrave for their active assistance in securing this representative series of such a rare and wily crustacean. One of us first secured a single specimen at Norton's Basin, on the Nepean River, New South Wales, fifteen years ago, and, though additional specimens have often been sought for, until recently, few have been obtained. These shrimps appear to occur only in running water and in rock localities (Pl. x, fig. 3) where there are stones for them to hide under. They apparently dislike any but clear water, and most of our specimens were secured after we had driven them from their hiding places by stirring up the sediment at the bottom of a small pool from which we had removed the loose boulders and stones. We stretched a cheese-cloth barrier across the only overflow from the pool, and, as each shrimp sought to leave the disturbed water by heading off down stream, it was trapped and lifted out with a small hand-net, together with small fishes, specimens of *Paratya australiensis* Kemp, and other of its neighbours. Adjacent pools, in which the conditions were apparently similar but into which the water had ceased to flow, had evidently been deserted by the *Atya*, as no specimens could be found in them though we adopted the same tactics as in the case of the productive pool. The amount of water flowing in the river at the time the shrimps were secured was very small, owing to a period of drought. None of the series were ovigerous, but three large females secured by Mr. Kinghorn at an earlier date carried an abundance of well-developed eggs.

These shrimps swim steadily forward through the water with an even movement, and only jerk backward by flexing the abdomen in the manner common to prawns as an extreme measure. They also run freely in an upright position over the flat surface of a table, and if thrown on their sides, will speedily regain their normal position. They readily left a shallow dish of water by crawling over its sides, a habit which is evidently associated with their migration from one pool to another when drought conditions cut off the supply of running water. Some highly interesting notes on the habits of an allied species, *A. molluscensis*, are given by Cowles[5], and the habits of *A. striolata* are probably not very different.

Locality.—Norton's Basin, Nepean River, New South Wales; 18th February, 1915; 16th to 23rd November, 1919; and November, 1920.

[5] Cowles—Philipp. Journ. Sci. x, Sect. D, No. 1, 1915, p. 11.

Family PONTONIIDAE.

Subfamily PONTONIINAE.

Genus PERICLIMENES *Costa*.

Subgenus ANCYLOCARIS *Schenkel*.

PERICLIMENES (ANCYLOCARIS) BREVICARPALIS (*Schenkel*).

(Figure 2.)

Palaemon sp. Saville-Kent, Barrier Reef of Australia, 1893, p. 145, col. pl. ii.

Periclimenes (*Ancylocaris*) *brevicarpalis* Kemp, Rec. Indian Mus. xxiv, 2, 1922, p. 185, pl. vi, fig. 8, and figs. 40-42.

This species is very common on the Barrier Reef in association with *Discosoma*, together with small fishes (*Amphiprion percula*) and an unidentified crab of the family *Porcellanidae*.[6] All three commensals are very brilliantly coloured, and are peculiarly helpless when deprived of the protection of their host. If the anemone be irritated so that it retracts within a crevice, its queerly assorted associates swim around in a dazed plight so that they can be easily captured by hand. They move about freely among the tentacles of the anemone, and are in no way affected by their stinging nematocysts. The anemone is unaffected by their movements, though it readily retracts when touched by one's hand or any other unfamiliar substance. The sting of these anemones is not appreciable, but the innumerable nematocysts of the bulbous ends of the tentacles penetrate the skin of one's finger so readily that the tentacles are torn from the animal as the hand is withdrawn. The power which enables it to discriminate between the delicate touch of a fish's fins, which leaves it undisturbed, and that of a wriggling worm, which it readily captures and ingests, is very difficult to understand.

A female specimen of *P.* (*A.*) *brevicarpalis* secured by one of us from an anemone in a lagoon at Hope Islands, off Cooktown, North Queensland, in 1918, was quite transparent, though the eggs, branchiae, and intestines appeared translucent brown; porcelain white areas were present on the cephalothorax and abdomen, distributed as in the accompanying figure,[7] and the two largest patches, on the median line, appeared granular. The antennal and antennular flagellae were pale violet. The chelipeds and fingers were transparent, with deep violet cross-bands at the joints, and across the fingers. The telson and uropods had each at its extremity a large orange yellow ocellus with a deep purplish violet margin; rest of tail-fan porcelain white.

Male examples obtained with the female were smaller and less ornate. The limbs and tail-fan were as described above, but the cephalothorax was only imperfectly marked, the eye markings being most conspicuous. Only the large median spot was present on the abdomen, the lateral ones being absent.

[6] Kent—Nat. in Austr., 1897, p. 220, pl. 39.

[7] The white marks on the cephalothorax and abdomen are copied from a drawing made in the field. This shows their relative positions, but does not indicate which particular segment they occur upon.

As Kemp (*loc. cit.*) has already noted, the colour of the species is very variable, and other examples from Port Denison and Saddleback Island, Queensland, are described by the donor, Mr. E. H. Rainford, as having the four ocelli on the tail-fan coloured rich brown with lighter centres. The other colours he noted agree with the above description. Further, some field notes made by one of us in 1907 at Murray Island, Torres Strait, describe a living specimen as being transparent, with four white scarlet-edged ocelli on each side, and one each of a similar colour on the telson and uropods. Legs with distal end of joints dark violet.

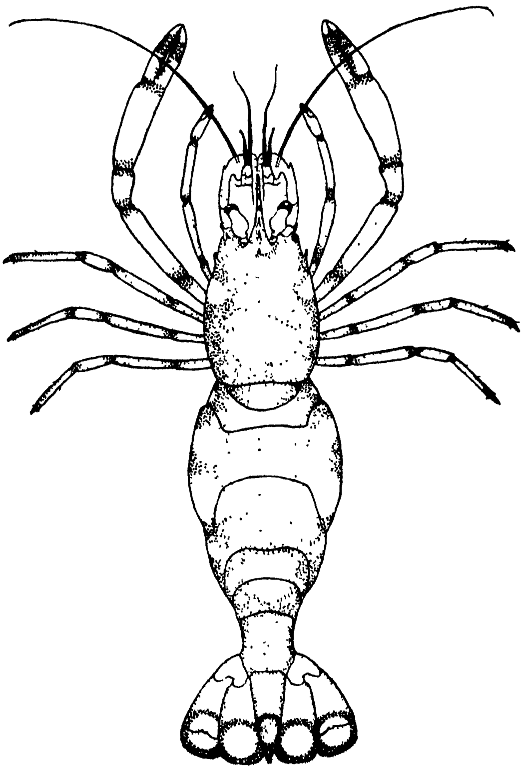

Fig. 2.

Periclimenes (Ancylocaris) brevicarpalis.

Ovigerous female measuring 30 mm. from tip of rostrum to end of telson.

Locality.—Hope Islands (lagoon), N. Queensland.

Localities.—Hope Islands (lagoon), off Cooktown, North Queensland; collected by A. R. McCulloch, 1918. Port Denison, Queensland; collected by E. H. Rainford, 1921. Saddleback Island, off Port Denison, Queensland; collected by E. H. Rainford, 1921.

AN ABORIGINAL MAGICAL PLATE.

By

William W. Thorpe, Ethnologist, Australian Museum.

(Figure 1.)

From Mrs. Daisy M. Bates, of Ooldea, South Australia, the Trustees have lately received an object, locally known as an *inma* or *eenma*, which is credited with magical properties. It was thought by the donor, who is *persona grata* amongst the aboriginals, to be a unique specimen, but this statement is open to modification. It consists of a thin pentagonal plaque of phyllite, a variety of slate, and is incised on both sides. For purposes of description, these faces will be referred to as the obverse and reverse.

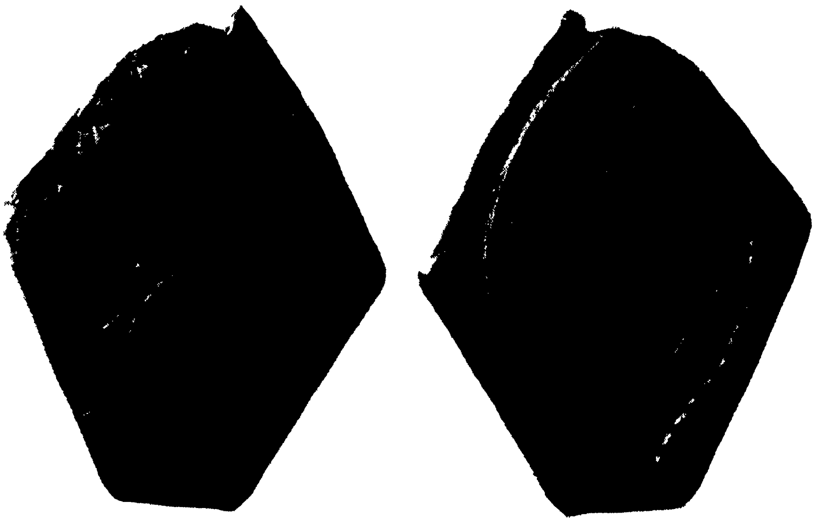

Fig. 1.

On the obverse, as a centrepiece, is a human figure, the head encircled by a radiating dance ornament known in parts of Western Australia as *wonnung-gi* or *tahlee*, and in each hand a *wandi* is held. About the middle of the figure is what appears to be a loin fringe, while each thigh bears incised cinctures. In the field may be seen three boomerangs of the *kylie* type. The figure is contained within a scalloped margin, outside of which parallel, or radiating lines appear, cut right to the outer edge. The design on the reverse is considered phallic. It seems to represent the female *pudenda*, or possibly a combination of both the male and female organs of generation. The parallel transverse flutings are of a coarser type than those on the obverse. There are traces of ruddle in some of the incisions. The object when received was contained within a padded envelope composed of matted emu feathers loosely bound with fur string, the latter terminated with tufts of woman's hair.

The following information has been supplied by Mrs. Bates:—

The specimen shows the figure of a man wearing the *wonnung-gi* or sacred head-dress—never seen by women—and on the other side is what I believe to be a phallic emblem. Maradhanu [a local native] brought it to me, and such was its ugly reputation, I think he was glad to give it to me, for I can keep evil magic from hurting them. It was brought to the camp as a powerful evil magic weapon, and Maradhanu—to whom it does not belong—took it from its hiding place, and brought it to me. A hole had been bored in it in order to hang it around the neck, but the hole had got broken. Looked at from the native standpoint it is rather gruesome, for if you run it upwards along a man's stomach he will die a very painful death; but if it is rubbed transversely by a friend it may heal a sick man.

It is a very important, and I think, unique object of magic. I have seen many *inma*, with their various carvings of group totems, but have never before seen the human figure *plus* the *wonnun-gi*, *i.e.*, the webbed head ornaments held in the hands of the dancing figure. The *inma* has probably been made by a nor'-west area artist, and has come down along the zigzag native highway past the heads of the Ashburton and Gascoyne Rivers to the W.A.-S.A. border. It is very old and has the bent knee of true native drawings. *Inma* of Ooldea = *Kalliguru* of the north-west; these names are also applied to the wooden bull roarers and other sacred and totemic marked boards.

The *inma* seems to be comparable, if not identical with the *tjurunga*[1] *arknanoa*, or festival plates, of the Finke River natives as described by the Rev. L. Schulze,[2] and similar to some of the corroboree stones of the Arunta tribe as depicted by Dr. E. Eylmann.[3] The firstnamed author emphasises both the sacredness of these objects and their esoteric significance, but does not attribute to them any magical properties. Eylmann, speaking of the Arunta, says that these plates can be divided into two groups, those having a beneficial influence and warding off evil, and others bringing death and trouble. These latter give the possessors the power to remove their enemies in a safe manner. He adds that both the material of which they are composed and their magical properties are inseparable, and if the owner of one dies it still retains its potency. Because of this feature, as an article of barter they are invaluable. This latter may explain the ancient appearance and great distance the *inma* under description has traversed.

The figures are of natural size.

[1] = *Churinga* of Spencer and Gillen and *Churina* of Gillen. *cf.* Spencer and Gillen, Native Tribes of Central Australia, 1899, p. 128 *et seq.*, and fig. 21; Horn Expedition iv, Anthropology, 1896, pp. 77 and 179.

[2] Schulze—Trans. Roy Soc. S.A. xiv, 1890-91, p. 42.

[3] Eylmann—Die Eingeborenen der Kolonie Südaustralien, 1908, pl. xxxi, figs. 2 and 3.

SOME SARCOPHAGID FLIES FROM LORD HOWE ISLAND.

By

PROFESSOR T. HARVEY JOHNSTON, M.A., D.Sc., and G. H. HARDY,
Walter and Eliza Hall Fellow in Economic Biology,
University of Queensland, Brisbane.

(Figures 1-3.)

Mr. A. Musgrave, Entomologist, Australian Museum, collected insects during December, 1921, on Lord Howe Island, an isolated spot consisting of a seven-mile stretch of land, over three, seven, and eight hundred miles from Australia, New Caledonia, and New Zealand respectively. Amongst them are some species of Diptera that are of interest owing to the similarity they bear to those of Australia.

Of the Sarcophagid flies described herein, two cannot be separated specifically from Australian forms, whilst the third is so similar to a continental species that the difference may possibly be considered to be of subspecific value only. It is possible that two of these species may have reached Lord Howe Island by natural means, such as by wind, or may have been transported by shipping, but we have reason to suppose that such an explanation is open to serious doubt.

Amongst the Diptera Brachycera collected, are two species of the genus *Anthrax* (used in the sense given by Hardy, 1921, *nec* Bezzi) that are apparently identical with two common forms known to us from Sydney. These species are selected for comment because in each case the larvæ are subterranean and predaceous, the fly occurring only where the native flora exists and not breeding in gardens; the imagos are apparently capable of only short flights, about fifty yards at the most, and do not fly during windy weather. Under these circumstances it seems impossible for these Bombyliids to have reached the island by natural agencies, and it is very unlikely that they should have been introduced. Moreover, the majority of the collection consists of Australian species or related flies. These facts suggest that Lord Howe Island may have obtained its dipterous fauna during a time when it was not so isolated as it is to-day.

A. S. Olliff, in his account of the insect fauna of the island,[1] makes no mention of any Diptera, but his study of the Coleoptera led him to state that the more conspicuous genera were peculiarly Australian, though the island possessed a number of highly modified endemic forms. He recorded the presence of quite a number of widely distributed beetles which had evidently been introduced.

[1] **Olliff—Austr. Mus. Mem. ii, 1889, p. 77.**

It must not be forgotten, however, that the breeding habits of Sarcophagids would favour their transportation to other localities by ships, within certain limits, as it has been shown that a period of twelve to eighteen days in summer, increasing to as much as twelve weeks in winter, may be passed in the combined larval and pupal stages in the case of common Australian species under observation in Brisbane.[2]

In this contribution to the knowledge of the insect fauna of Lord Howe Island, the three species are described rather fully.

TERMINOLOGY.

A paper revising the Australian Sarcophagids is in course of preparation. It has been found advisable not only to modify the terminology used in papers previously issued from this laboratory, but also to take into account characters that have not received adequate treatment in the past. This contribution is written on similar lines to those of the proposed revision.

Chaetotaxy.—The terminology employed is that utilised by Williston in his "Manual of North American Diptera," 3rd edit. The terms describing the bristles of the legs are those recently used by the junior author in describing *Asilidae.*[3]

Genitalia.—Some structures of the male genitalia have been studied in detail. A pair of forceps protects the genital opening when the penis is withdrawn. On each side of the latter there is an anterior (a.c.) and a posterior (p.c.) clasper. The penis consists of two joints, the second of which is usually complex. Anterior to the main mass of the latter joint there is an anterior appendage (a.a.), which varies greatly in shape and size in different species. The main portion of the second joint contains processes that vary in size, form, and position, while between it and its appendage a pair of filaments (fil.) may be present or apparently absent.

Genus SARCOPHAGA *Meigen.*

The Australian species placed under the genus *Sarcophaga* may not belong to it, if used in its very restricted sense, and they certainly do not agree in regard to the characters given by Townsend in his keys.[4] This author has already proposed a new generic name for a species which was subsequently considered to be a synonym of an Australian form, but neglected to give the characters whereby his proposed genus may be recognised, and we are not in a position to validate his genus by defining it. Until definite information with regard to its generic position is obtained, *Sarcophaga* is utilised by us in its wider sense.

[2] Johnston and Tiegs—Proc. Roy. Soc. Queensland, xxxiv, 1922, pp. 77-104.
[3] Hardy—Proc. Linn. Soc. N.S. Wales xlv, 1920, p. 187.
[4] Townsend—Proc. Biol. Soc. Washington xxx, 1917, p. 189-198.

The following characters are based on species from Australia and Lord Howe Island.

Chaetotaxy.

Head.—Two pairs of vertical bristles, the outer often reduced in size but rarely quite obsolete. One pair of frontal orbitals, reclinate; also, in the female only, two pairs of proclinate bristles. At least two pairs of postverticals. The series of frontal bristles, composed of a row on either side parallel to the frontal stripe, extends below the base of the antennæ. The arrangement of the following bristles has been found to be of specific value:—The facials (a single, rarely a double row above each vibrissa); those along the oral margin (one row below the vibrissa, rarely a double row); and the postocular (invariably one row, but supplemented by the vestiture behind this row becoming at times bristly and black, so as to form one or two additional rows).

Thorax.—On each side of the median line are the following:—Three humeral bristles; two posthumeral; four notopleural, alternately short and long; one presutural; four supra-alar, the fourth often small or minute; two postalar; normally eight dorsocentral, four of which are postsutural.

The intra-alar and acrostichals are of specific value; the former are usually regarded as consisting of two or three bristles, but sometimes the row can be detected extending to include three further bristles, one of which is anterior, the other two posterior to the suture. The acrostichals utilised in our descriptions consist of one presutural and one prescutellar, though others may occur, but are difficult to detect with accuracy, as when present they are invariably surrounded by rather long vestiture.

Two propleural bristles; a row of five mesopleural along the mesopleural suture; three sternopleural arranged 1:1:1; a group of about three pteropleural just below the wings; a row of hypopleural; and between the anterior and intermediate coxae, on the sternopleura, a row of bristles similar in nature and parallel to those of the intermediate coxae.

Scutellum.—Four pairs of bristles on the male, and three on the female.

Abdomen.—On each side of the first segment there are one or two submarginal bristles and anterior to these are some discal bristles arranged in one or two rows. The second segment has one or two lateral submarginals, very seldom three; very rarely a median pair of submarginals. The third segment usually has one median pair of submarginals and one or two laterals, but sometimes other bristles occur, making as many as six submarginals. The fourth segment has a complete system of submarginals, often alternating with slender bristles placed marginally, the series continuing ventrally.

Legs.—The bristles of the femora are arranged in rows of few or many; when a row is reduced so that only the apical one, two or three bristles remain, these are referred to as subapical bristles. The tibiæ, when reflexed, lie between the two ventral rows, the anterior of which is invariably missing on the anterior pair of legs. The coxæ and tibiæ also contain bristles, but these do not seem to be of particular value.

The hairy vestiture of the femora and tibiæ occurs in three forms: pubescence which is very short and uniform in size and distribution, some short hair and long hair. An examination of any species that has one or more of its femora conspicuously hairy will enable anyone to distinguish between these forms. Only long hair is taken into account for the purpose of descriptions.

Wings.—There do not appear to be any characters of specific value to be found in the wings; the first vein, R_1, invariably contains a row of bristly hairs at the base, the other veins being bare.

COLOUR.

The Australian Sarcophagids known to us are all of a uniform type in colour and colour markings. The tomentum ranges in colour from grey and silver-grey to golden yellow, and it may vary considerably in this respect even within a species. The legs and forceps are black, or at most the latter are dark brown, never red (as is the case with so many North American species).

SARCOPHAGA HOWENSIS *n. sp.*

(Fig. 1.)

Resembles *Sarcophaga beta* Johnston and Tiegs, to which it is closely allied and possibly is only subspecifically different.

♂.—*Head.* Frontal stripe wider than parafrontals, third antennal joint over twice the length of the second (proportion 7 : 3). Outer verticals scarcely longer than postorbitals; twelve frontals; facials numerous, about two rows of nine or ten each; the bristles along the oral margin are also placed in a double row and are of similar numbers; one postorbital row.

Thorax. Three definite intra-alar bristles and along the same row are two postsutural and one presutural weak bristles; prescutellar and presutural acrostichals present.

Abdomen. A line of three discal and one submarginal lateral bristles on the first segment; the second and third have each one median and two lateral pairs of submarginal bristles; the fourth segment has six pairs of submarginal bristles, alternating with slenderer marginal ones which constitute a series that continues ventrally.

Genitalia. The forceps are long and sinuous, and conform in every detail to those of *S. beta*; the claspers are also identical with those of *S. beta* and consist of bifid anterior and very broad posterior claspers; anterior to these there is a minute knob. The penis conforms in general shape and structure to *S. beta*, but differs at the apex in having a pair of lateral spur-like processes and shorter filaments, this difference being illustrated in the accompanying diagrams (fig. 1, E, F).

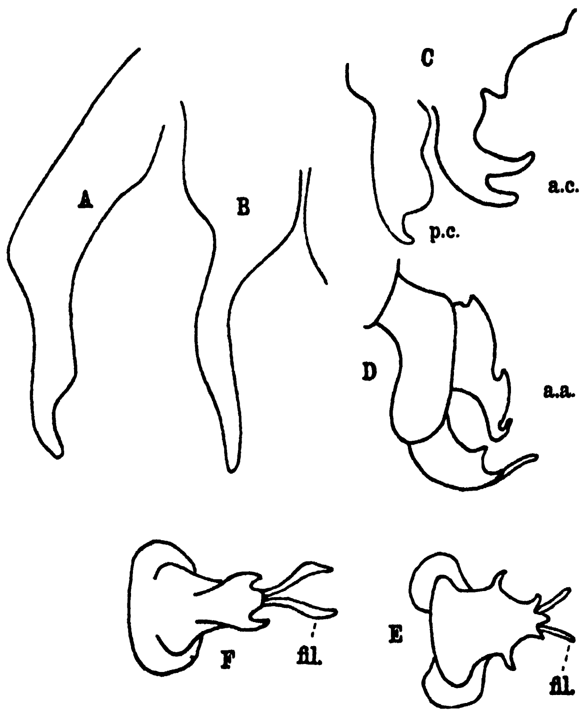

Fig. 1.

Sarcophaga howensis n.sp.

A. one of the forceps seen laterally.

B. posterior view of same.

C. claspers viewed laterally.

D. penis (second joint) seen laterally.

E. the same, ventral view.

Sarcophaga beta Johnston and Tiegs.

F. the penis seen from the same aspect as that of E.

a.c., anterior clasper. p.c., posterior clasper.

a.a., anterior appendage. fil., filaments.

Legs. On the anterior femora one dorsal and one ventral row of bristles; on the intermediate femora one anterior row, two subapical bristles on the posterior side and two ventral rows; on the posterior femora, one anterior and one dorsal row, one posterior subapical bristle and two ventral rows considerably reduced in regard to the number of bristles present. Long hair abundant on all femora and on intermediate and posterior tibiae.

♀.—Unknown.

Length.—Male, 10-15 mm.

Hab.—Lord Howe Island; holotype and three paratypes; December, 1921.

SARCOPHAGA MISERA *Walker.*

(Fig. 2.)

♂.—*Head.* Frontal stripe slightly wider than parafrontals. Third antennal joint twice the length of the second. Outer vertical bristles minute; ten frontals; about five facials; about twelve orals; one row of bristles behind the eyes.

Thorax. Two intra-alar bristles and one pair of strong prescutellar acrostichals.

Abdomen. On the first segment, three discal and one submarginal lateral bristles; on the second, one submarginal lateral; on the third, one median and two lateral submarginals; on the fourth, six submarginal bristles alternating with more slender ones which constitute a series continued ventrally.

Genitalia. The forceps are small and taper uniformly to the tip. The anterior and posterior claspers are simple. The penis contains one anterior appendage and two pairs of lateral processes, one of which is elongate and bifid at the tip. A pair of filaments scarcely protrudes beyond the apex of the second joint.

Legs. On the anterior femora one dorsal, one lateral, and one ventral row of bristles; on the intermediate femora, one anterior row, three subapical posterior bristles, and two ventral rows; on the posterior femora, one anterior row, one subapical dorsal bristle, one subapical posterior bristle and one ventral row. Long hair occurs on the intermediate and posterior femora, and also scantily on the posterior tibiæ.

♀.—In addition to the modifications in chætotaxy, which occur in Australian female Sarcophagids, and are referred to in the generic characterisation already given, it differs in having larger outer vertical bristles, three intra-alar bristles, three lateral marginals on the third abdominal segment, and long hair only on the posterior femora.

Length.—Male and female about 11 mm., but as the male has been attenuated in extracting the genitalia, and the female has conspicuously shrunken, the measurements can only be given approximately.

Hab.—Lord Howe Island; December, 1921; one of each sex. Previously recorded as widely distributed over Australia.

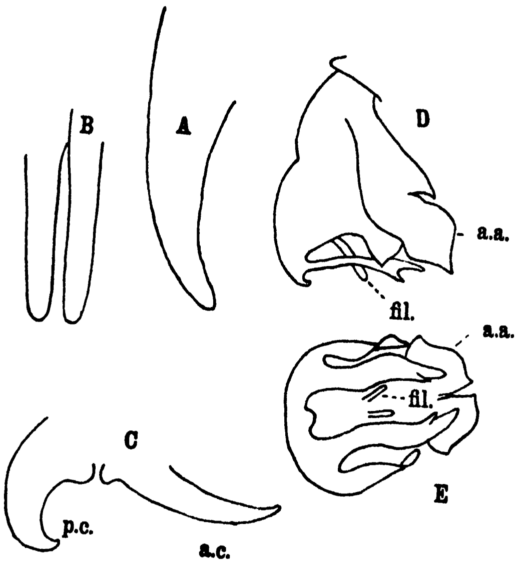

Fig. 2.

Fig. 2, *Sarcophaga misera* Walker.

A. one of the forceps seen laterally.
B. posterior view of same.
C. claspers viewed laterally.
D. penis (second joint) seen laterally.
E. the same, ventral view.

a.c., anterior clasper. p.c., posterior clasper.
a.a., anterior appendage. fil., filaments.

Note.—This species is closely related to *Sarcophaga dux* Johnston and Tiegs, *nec.* Thomson, but there are certain differences in regard to the structure of the genitalia. Besides, the presence of a second postocular row of bristles in *S. dux* will readily distinguish that species.

Genus HELICOBIA *Coquillett.*

This genus was founded upon the character of the third vein of the wing (R_{4+5}, Comstock and Needham's terminology), which has a row of bristles. According to Townsend's key both sexes described below belong to the genus, so there can be little doubt that the species has been rightly included in *Helicobia* as now understood.

Chaetotaxy.—Similar to that given under the genus *Sarcophaga,* but differing in the postsutural dorsocentrals, which are only three in number.

Genitalia.—Very distinctive in appearance from those of the genus *Sarcophaga.* A drawing, taken direct from the holotype of *H. australis,* is given here, and it will be noted that the apices of the parts of the second joint of the penis terminate together in a long complex process. This joint, taken from another specimen, has been mounted on a micro-slide and it shows definitely that the filaments are also contained in this complex process. The genitalia of the specimen described agrees in every respect with those of the holotype.

HELICOBIA AUSTRALIS *Johnston and Tiegs.*

(Fig. 3.)

♂.—*Head.* Frontal stripe wider than parafrontals. The second antennal joint a little larger than in the holotype (proportion, in relation to third joint, 5 : 9 in the holotype, and 7 : 8 in the specimen described). Outer vertical bristles slightly longer than those of the postorbital row; ocellar bristles very strong; eight frontals (in the holotype seven on one side and six on the other); three facials, and at least four bristles along the oral margin; three rows of black bristles behind the eyes.

Thorax. The fourth supra-alar, if present, no longer than the bristly vestiture of the thorax; three intra-alar; five well developed dorsocentrals, others are present but conspicuously weaker; one pair of prescutellar acrostichals (others, if present, cannot be detected from the bristly vestiture around them).

Abdomen. On the first segment four discal (arranged 2 : 2) and one submarginal lateral bristles (all of which are somewhat obscured in the holotype), on the second, one lateral submarginal; on the third, one pair of median and two lateral submarginals; on the fourth segment, seven pairs of submarginals.

Genitalia. Forceps short. Anterior clasper remarkably flattened, almost spoon-shaped, showing anterior and posterior surfaces only; posterior clasper simple. Second joint of penis compact; with the anterior appendage diverted back, provided with a short lateral process and apically attenuated. This anterior appendage, together with the apex of the main portion of the second joint and a pair of filaments, forms a complex apical process to the joint (Fig. 3 D, E).

Legs. On the anterior femora one dorsal row, two closely adjacent rows of bristly vestiture and one ventral row of bristles. On the intermediate femora one anterior row, two subapical bristles on the posterior side and two ventral rows of small bristles. On the posterior femora one anterior row, two dorsal subapical bristles and two ventral rows. No long hairs on the legs, the vestiture, like that on the other portions of the insect, being bristly in nature, making the true bristles sometimes difficult to detect.

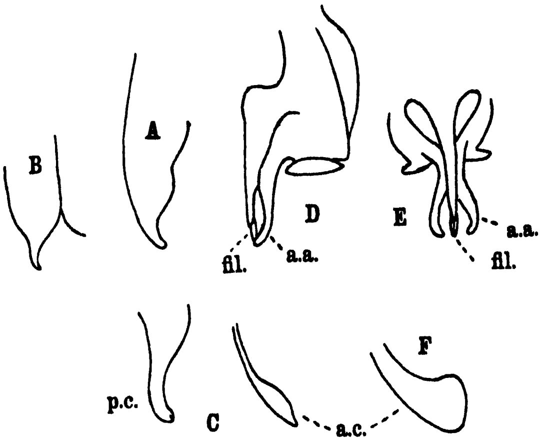

Fig. 3.

Fig. 3, *Helicobia australis* Johnston and Tiegs.

A. one of the forceps seen laterally.
B. posterior view of same.
C. claspers viewed laterally.
D. penis (second joint) seen laterally.
E. posterior view of penis.
F. posterior aspect of anterior clasper.

a.c., anterior clasper. p.c., posterior clasper.
a.a., anterior appendage. fil., filaments.

♀.—In addition to the modifications in chætotaxy, which also occur in the Australian species of *Sarcophaga* and are referred to under the characters of that genus, it differs from the male in having strongly developed outer verticals; third joint of the antenna twice as long as the second; six pairs of submarginal bristles on the third and fourth abdominal segments; and the two rows of bristly vestiture on the posterior side of the anterior legs wider apart.

Length.—Male, 6 mm.; female, 5-7 mm.

Hab.—Lord Howe Island; December, 1921. Three males, allotype female and five paratype females. Previously recorded from Queensland, and represented in the Australian Museum by one male from Dorrigo, N.S. Wales.

Note.—Except where stated the above description of the male agrees in every respect with the holotype.

LIST OF WORKS CONSULTED.

Coquillett. In Johnson—Diptera of Florida, with additional descriptions of new genera and species by D. W. Coquillett. Proc. Acad. Nat. Sci. Phil., 1895, pp. 303-340.

Johnston and Tiegs. New and little known Sarcophagid flies from South East Queensland. Proc. Roy. Soc. Queensl., xxxiii, 1921, pp. 49-90; 26 figs.

——————— Sarcophagid flies in the Australian Museum collection. Rec. Austr. Mus., xiii, 1922, pp. 176-188; pl. xxxv, and two text figures.

——————— Notes on the Biology of some common Queensland Muscoid flies. Proc. Roy. Soc. Queensland, xxxiv, 1922, pp. 77-104.

Townsend. Genera of the Dipterous tribe Sarcophagini. Proc. Biol. Soc. Washington, xxx, 1917, pp. 189-198.

ON THE OCCURRENCE OF A TRUE ALLANTOPLACENTA OF THE CONJOINT TYPE IN AN AUSTRALIAN LIZARD.

(Preliminary Communication.)

By Professor T. Thomson Flynn, D.Sc., University of Tasmania, Hobart.

(Figures 1-2.)

My attention was recently directed by Mr. J. R. Kinghorn, of the Australian Museum, to some material in the Museum, registered under the number R.7945, and labelled "Eggs, *Tiliqua scincoides,* loc. Hornsby, N.S.W. Oct., 1922."[1]

The material was found to consist of the two oviducts, in which were contained a number of "eggs," these causing large swellings spaced at intervals along the course of the ducts. When some of these swellings were opened, the interesting fact was revealed that the allantois enters into distinct relationship with the wall of the oviduct, and there is thus produced an allantoplacenta of a very definite type.

The history of this specimen is as follows:—

It was found in a garden at Hornsby, New South Wales, by a lady, who, in ignorance of the harmlessness of the reptile, smashed its head with a spade. In the damaged condition, it was brought to the Museum, and upon examination proved to be a female. The oviducts in their pregnant condition were removed by Mr. Kinghorn, and placed in Bles' fluid (70% alcohol, 90 parts; 5% formol, 7 parts; glacial acetic acid, 3 parts). Later, the material was transferred to alcohol. The adult, in its damaged condition, was not preserved.

There is an element of doubt, very slight it is true, as to whether this adult specimen was correctly identified.

Of the skinks found in New South Wales, there are two which are alike in general appearance and habits, which differ but slightly in their markings, and which are best distinguished by the difference in the arrangement and degree of development of the head shields. These lizards are *Tiliqua scincoides* Shaw, and *T. nigrolutea* Gray. It is probable that both of these are viviparous, but it is a matter for surprise that the records on this subject are so few and so vague.

[1] The date refers to the time, not of collection, but of registration in the Museum records.

The available evidence is as follows:—

(*a*) Haacke[2] records the viviparity of *Cyclodus Boddaertii*, part Dumeril et Bibron, from South Australia, and states that his specimen contained four embryos, two in each uterus. *C. Boddaertii* is a synonym of the Australian lizard *T. scincoides*, although it is still possible that Haacke had in his possession a pregnant specimen of *T. nigrolutea*, which is also found in South Australia.

(*b*) Graham Kerr[3] refers to *T. scincoides* as being viviparous.

(*c*) Lucas and Le Soeuf[4] make the statement that "*T scincoides* appears to be oviparous, while the young of *T. nigrolutea* are brought forth alive, in each case the number of young being 6 to 15."

(*d*) Mr. E. A. Briggs, B.Sc., of the Zoological Department of the University of Sydney, has allowed me to examine a number of embryos removed from the oviducts of a *Tiliqua* which he believes to have been *T. scincoides*, but on this point he is not perfectly satisfied.

(*e*) In the Australian Museum there are preserved three advanced embryos, registered as R.2493-5, and labelled "Lithgow, April, 1899," and stated to be from *T. nigrolutea*.

In New South Wales, *Tiliqua nigrolutea* is confined to the colder portions, the south and the highlands of the centre. It has not been recorded, so far as I know, north of the Blue Mountains. It is therefore probable that the Hornsby specimen on which this paper is founded and the Sydney University *Tiliqua* (which came from Manly) both belong to the species *scincoides*.

Despite the statement of Lucas and Le Souef, quoted above, it may be taken for granted that each of the New South Wales species of this genus is viviparous.[5]

Description of Material.

This consists of the greater portions of the two oviducts, with the ovaries. At intervals, the ducts are greatly enlarged, each enlargement corresponding to a developing embryo with its membranes and yolksac. Many of the embryos had been taken out of the oviducal swellings, the total number—removed and intact—being fifteen, which agrees with the maximum number given by Lucas and Le Souef for the genus (but see Haacke as quoted above).

[2] Haacke—Zoologischer Anzeiger, viii, 1885, p. 438.

[3] Graham Kerr—Text Book of Embryology, Vertebrata, London, 1919, p. 482.

[4] Lucas and Le Soeuf—The Animals of Australia, 1909, p. 248.

[5] The matter has been definitely settled in the case of *T. scincoides* by the receipt, after the above was written, of a pregnant specimen of this species. From it were secured eleven embryos, six from the right oviduct, five from the left. These embryos are near full term, with reduced yolksac and well developed placenta, and have the following measurements: Total length, 100 mm.; head length, 22 mm.; length measurement from vent to tip of tail, 31.5 mm.

Each swelling is elliptical in shape, measuring on the average some 23 mm. by 18 mm., the longer diameter lying in the same direction as the length of the duct. There are signs that there has been some shrinkage since the material has been put in spirit.

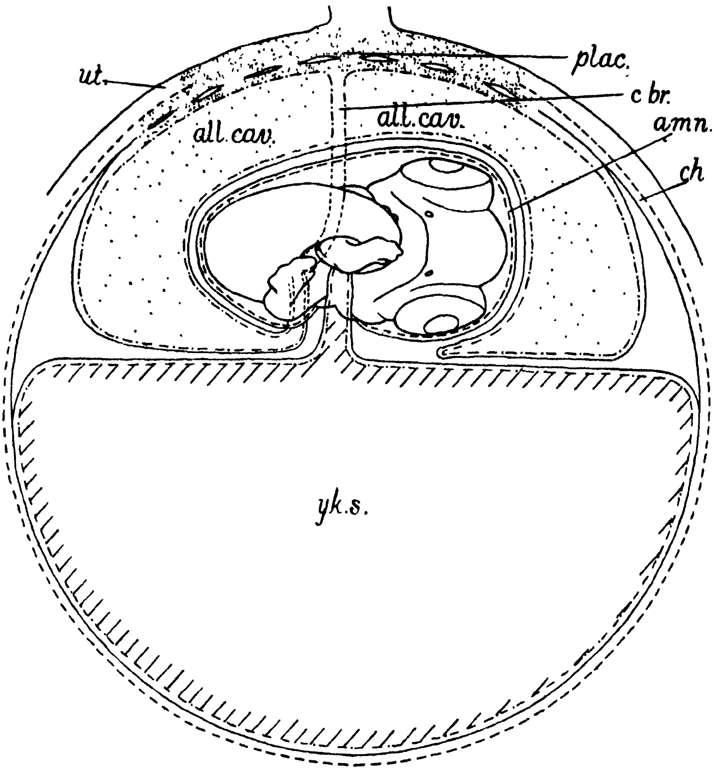

Fig. 1.

Diagram of the Fœtal Membranes of the Embryo of *Tiliqua scincoides* of 8·5 mm.

The ectoderm is indicated by a broken line, the mesoderm by an unbroken line, the entoderm by "dot and dash."

All. cav. = allantoic cavity; *amn.* = amnion; *c. br.* = cellular bridge carrying vessels across the allantoic cavity; *ch.* = chorion; *pl.* = placental formation; *ut.* = uterine wall; *yk. s.* = yolk sac.

Between the enlargements, each oviduct is contracted, having the form of a strap-shaped body measuring some 3 mm. by 5 mm. The length of oviduct between the swellings varies slightly, but it is, on the average, about 10 mm.

Where it is swollen, the wall of the oviduct is thin, and through it the various regions of the embryonic "vesicle" can be made out. The orientation of the vesicle is such that the embryo is towards the mesometrial side of the duct. The embryo measures 8.5 mm. in direct length, and lies with one side on the yolksac. A drawing of it at this stage is shown in Figure 2. The yolksac occupies rather more than half the whole embryonic structure.

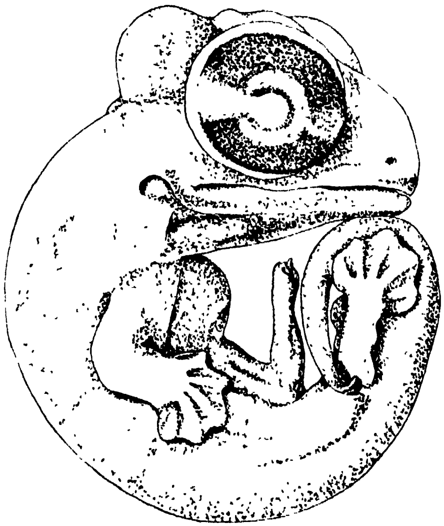

Fig. 2.

Embryo of *Tiliqua scincoides* measuring 8·5 in direct length.

The side which the embryo presents to the yolksac is almost invariably the left, in but one case out of twelve there being any exception to this rule. The outlines of the embryos, and particularly their eyes, can be seen through the distended oviduct wall. The yolksac circulation is well established, and extends over the whole of the outer surface of the sac with the exception of a small area at the lower pole. A *sinus terminalis* could not be definitely made out.

There are no traces, as far as can be seen, of shell, shell-membrane, or albumen.

The Allantois.- This consists, as usual, of a stalk and an expanded hollow portion, the vesicle.

The whole allantois is somewhat voluminous, and wraps cosily round the embryo as it lies on the yolksac surface. The stalk of the allantois leaves the body of the embryo just behind the yolkstalk, and passing slightly downward and outward over the posterior end, almost immediately expands to form the extremely tenuous inner wall of the

allantoic vesicle. Posteriorly, the inner wall of the vesicle comes into delicate relationship with the upper surface of the yolksac. Anteriorly it passes over the body of the embryo, coming into intimate union with the amnion. External to this it extends over to the flat upper portion of the yolksac surface.

The outer wall of the allantoic vesicle is thicker and denser than the inner wall. It is this outer wall, naturally, which helps to form the placenta, but only its central portion fulfils this duty, the marginal zone of this face being free and unattached.

The Allantoplacenta.—This is formed by the reaction and, in part, fusion of the fœtal membranes of the embryo with the uterine wall of the mother. The chorion is attached over a wide area, very little of it being free. An examination of the University specimens, which I have been able to see by the courtesy of Mr. E. A. Briggs, brings into prominence the extremely important point that the chorion over the embryo begins to proliferate at a fairly early stage. These embryos measure 4 mm. in direct length, and the allantois is as yet only a thick-walled diverticulum, of small size, from the hind gut. Unfortunately, the maternal structures were not kept, and the important evidence afforded by the uterine wall is not available.

Possessing as I do but one definitely placental stage, it is not easy to state with exactness what alterations have taken place in the various fœtal and maternal structures which enter into the formation of the allanto-placenta.

The union between the chorion and uterine epithelium is very intimate. The uterine epithelium apparently consists of a single layer of very flattened cells, while the chorionic ectoderm has proliferated greatly, is much vacuolated, resembling a typical plasmodium, and is formed, in the main, of markedly enlarged cells with large nuclei and connected together by amœboid processes. These processes insinuate themselves into and between the maternal cells in much the same way as Hill[6] has described for the chorionic cells in the formation of the metrioplacenta of *Dasyurus viverrinus*.

With this previously prepared tissue, the allantois fuses by its placental surface. This is not, at this stage, a complete union, but occurs at a large number of points. Where there is no fusion, the allantoic surface is separated from that of the chorion by spaces which act seemingly as reservoirs for amorphous material apparently secreted by the chorion and obtained from maternal sources.

The area of attachment is discoidal, and measures, approximately, 16 mm. in diameter.

Allantoic Vessels.—The stalk of the allantois carries allantoic vessels to the inner wall of the vesicle, over which they spread, and are then carried round the margin to the placental face.

Hill—Anatomisches Anzeiger, xviii, 1900, p. 369.

But the outer wall of the vesicle is also supplied by vessels which leave the allantoic stalk near the body of the embryo, and pass right across the vesicle to ramify through the mesenchymal layer of the placental face of the allantois. The presence of such a method of transmission of allantoic vessels—by direct cellular bridges across the allantoic cavity—is interesting in that it has already been recorded by Hubrecht[7] for a monodelphian mammal, *viz.*, *Erinaceus*.

The importance of the investigation of the reptilian allanto-placenta cannot be over-emphasised. As Graham Kerr says, in his review of Giacomini's work on *Chalcides* (*Seps*), it is likely to prove the beginning of a new and important chapter in vertebrate embryology.[8]

Arrangements are now being made for the collection of further stages in the development of *T. scincoides* and *T. nigrolutea*, and, it is hoped that, with the help of these, it will soon be possible to publish a more detailed and connected account of this most important and significant phenomenon.

In conclusion, I must express my thanks to the Trustees of the Australian Museum and to their Director, Dr. C. Anderson, M.A., for permission to use the specimen and for accommodation and materials while working on it. To Mr. Kinghorn I can only express my appreciation of the skill and enthusiasm shown by him in dissecting, fixing and preserving this unique specimen.

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[7] Hubrecht—Quart. Journ. Micr. Sci., xxx, 1889, pp. 307-8.

[8] It is unfortunate that none of Giacomini's earlier papers appear to be available in Australia.

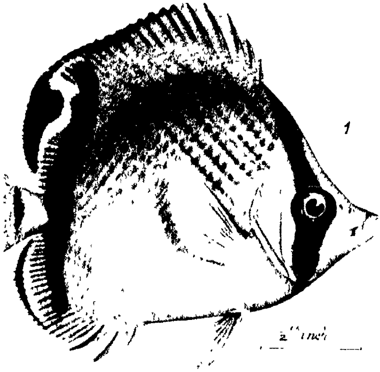
EXPLANATION OF PLATE I.

Fig. 1. *Chaetodon vagabundus* Linnaeus. A young specimen, 54 mm. from Murray Island, Torres Strait.

„ 2. *Chaetodon vagabundus* Linnaeus. A very young specimen, 24 mm. long, from the New Hebrides.

„ 3. *Cubiceps caeruleus* Regan. Lord Howe Island.

„ 4. *Cubiceps baxteri* sp. nov. Holotype, 371 mm. long without the tail, from Lord Howe Island.



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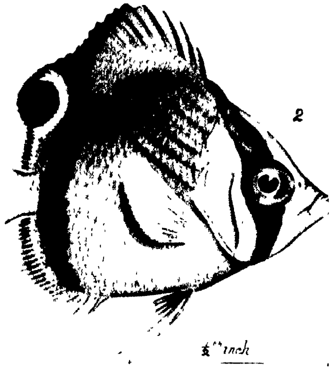

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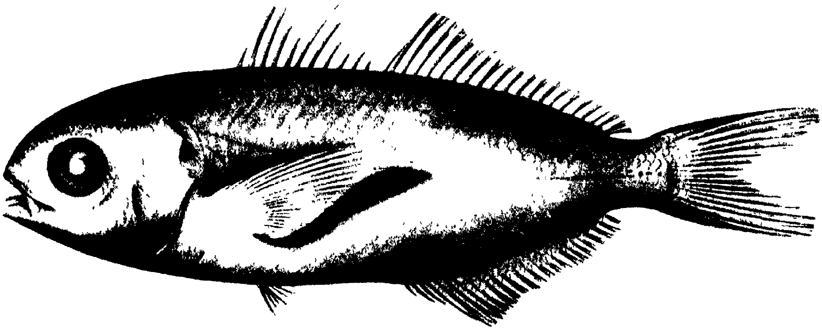

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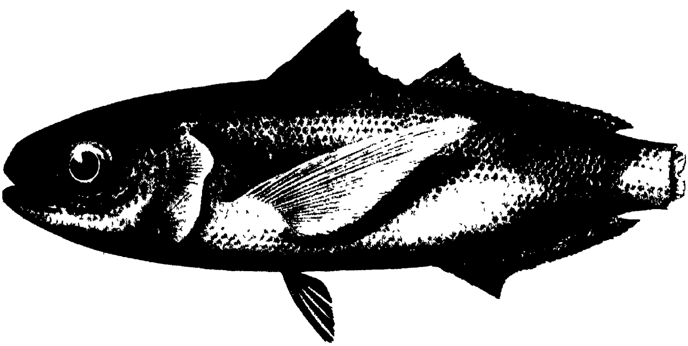

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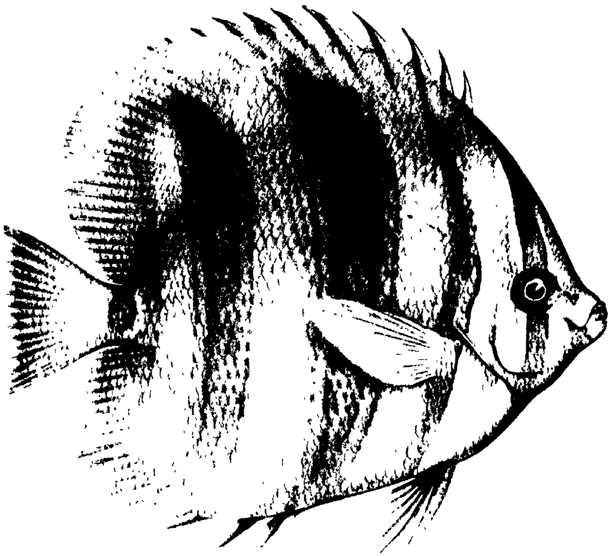
A. R. McCulloch, del.

EXPLANATION OF PLATE II.

Fig. 1. *Chaetodon rainfordi* sp. nov. Holotype, 118 mm. long, from Holbourne Island, off Port Denison, Queensland.

,, 2. *Chaetodon aureofasciatus* Macleay. A specimen, 111 mm. long, from Holbourne Island, Queensland.



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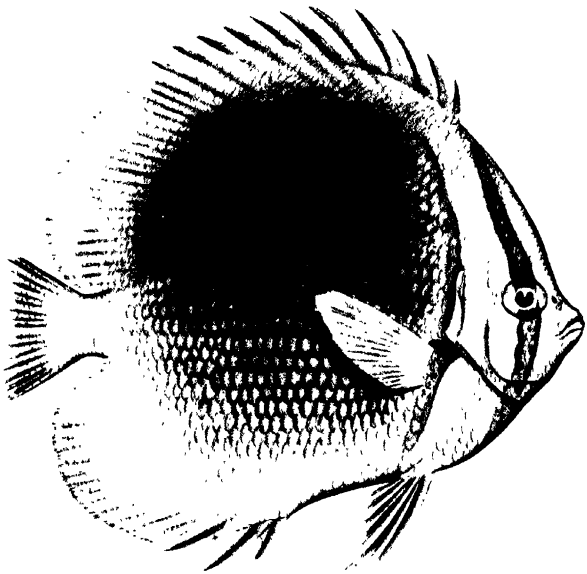

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A. R. McCulloch, del.

EXPLANATION OF PLATE III.

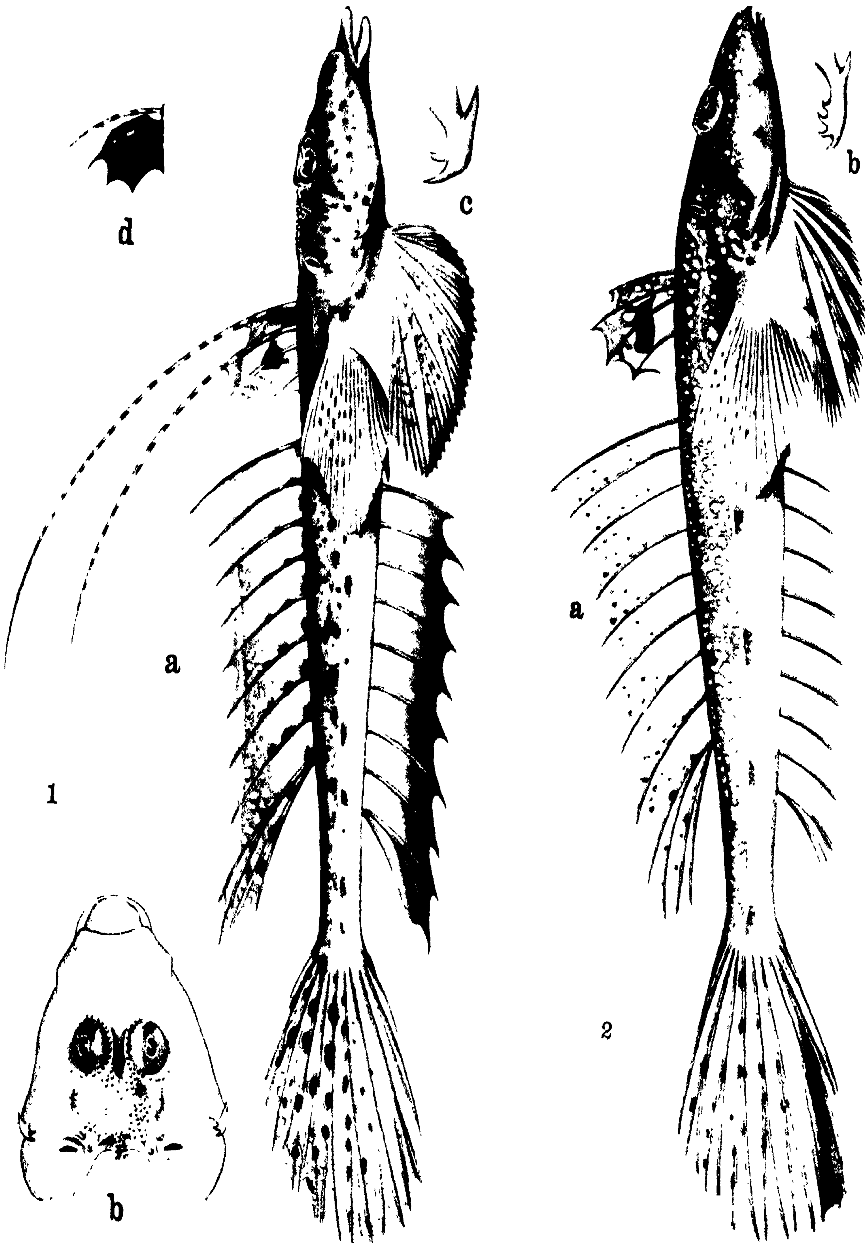
Fig. 1. *Callionymus limiceps* Ogilby. *a.* A male example, 216 mm. long, from near Cape Capricorn, Queensland.

b. Head of same specimen.

c. Preopercular spine of same specimen.

d. Dorsal fin of female.

„ 2. *Callionymus calcaratus* Macleay. A specimen, 242 mm. long, from Port Jackson.



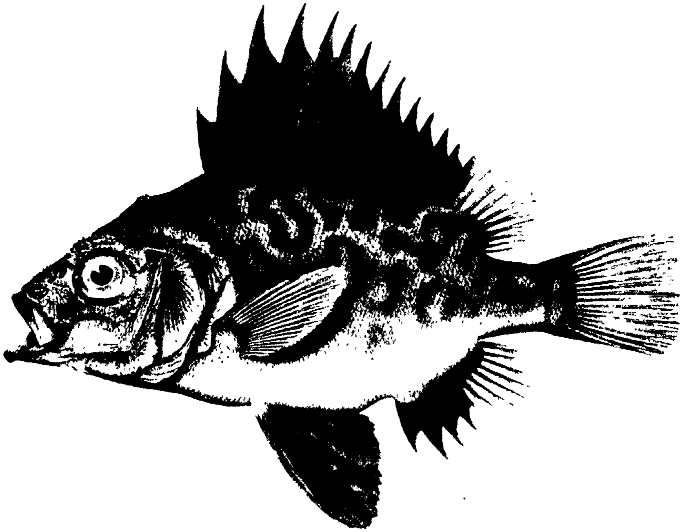
A. R. McCULLOCH, del.

EXPLANATION OF PLATE IV.

Fig. 1. *Pseudopentaceros richardsoni* Smith. A young specimen, 70 mm. long, from Nelson, New Zealand.

„ 2. *Cheimarrichthys fosteri* Haast. A specimen, about 147 mm. long, from Eight Mile, Hokitika River, New Zealand.

„ 3. *Tripterygion segmentatum*, sp. nov. Holotype, about 21 mm. long, from Shag Point, Otago, New Zealand.



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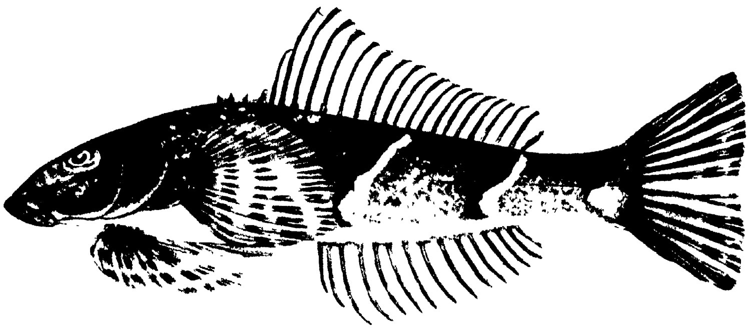

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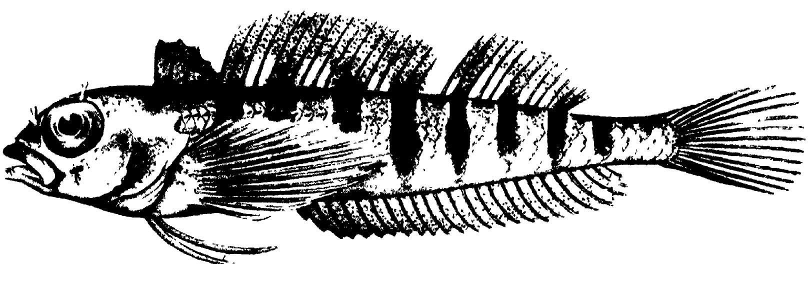

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A. R. McCulloch (1. 3),
F. E. Clarke (2), del.

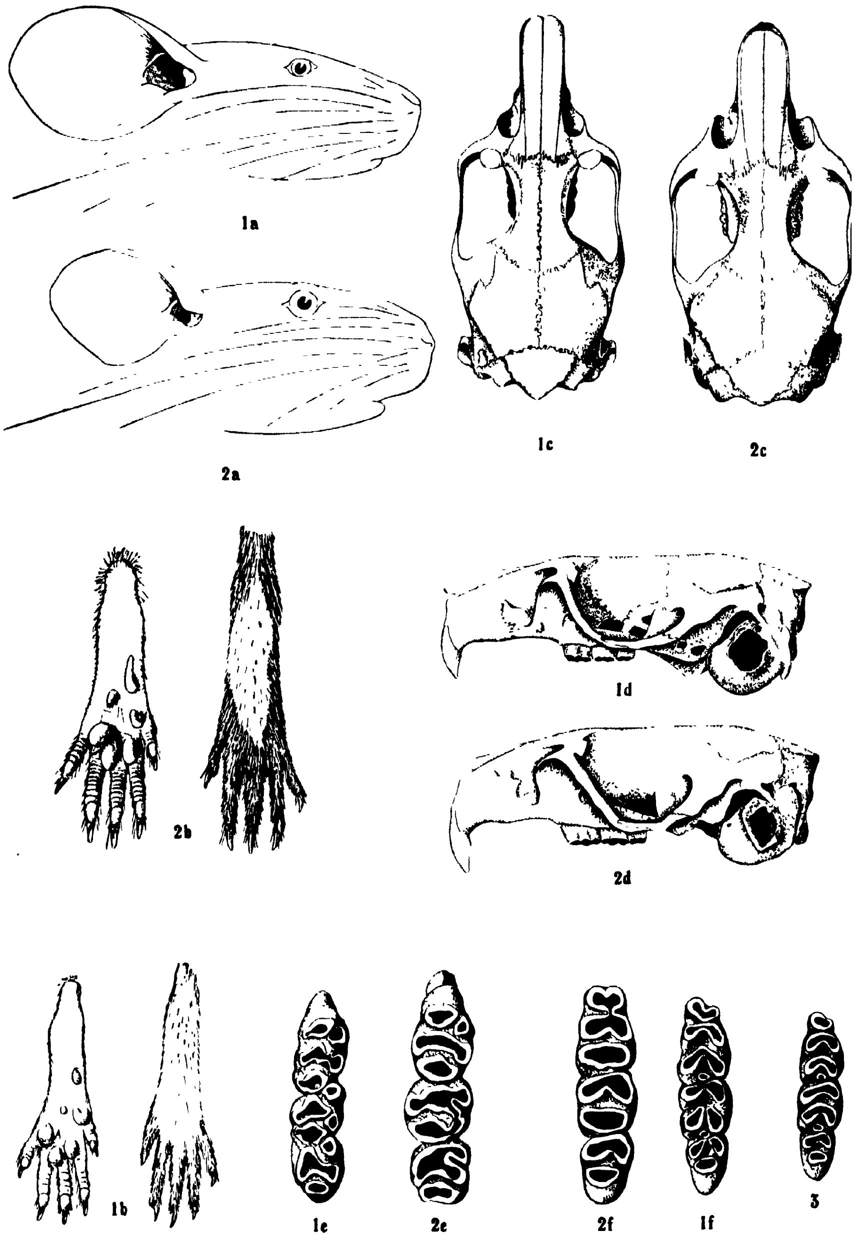
EXPLANATION OF PLATE V.

Fig. 1. *Leporillus conditor* Gould.

„ 2. *Leporillus jonesii* Thomas.

„ 3. *Leporillus apicalis* Gould. Lower molar row.

a. Outline of head.
b. Upper and lower surface of foot.
c. Skull from above.
d. Skull, profile.
e. Upper molar row.
f. Lower molar row.



J. R. Kinghorn and H. O. Fletcher, del.

EXPLANATION OF PLATE VI.

Fig. 1. Dongas, or "dongholes," on the Nullarbor Plain. These shallow depressions in the plain are practically "oases" where the vegetation is heavier, and where the animal life congregates.

,, 2. Stick nest built by the indigenous rodent, *Leporillus conditor* Gould, with the eggs of a Striped Brown Hawk (*Ieracidea berigora* V. and H.) in a depression on its summit.

1

2

E. Le G. Troughton, photos.

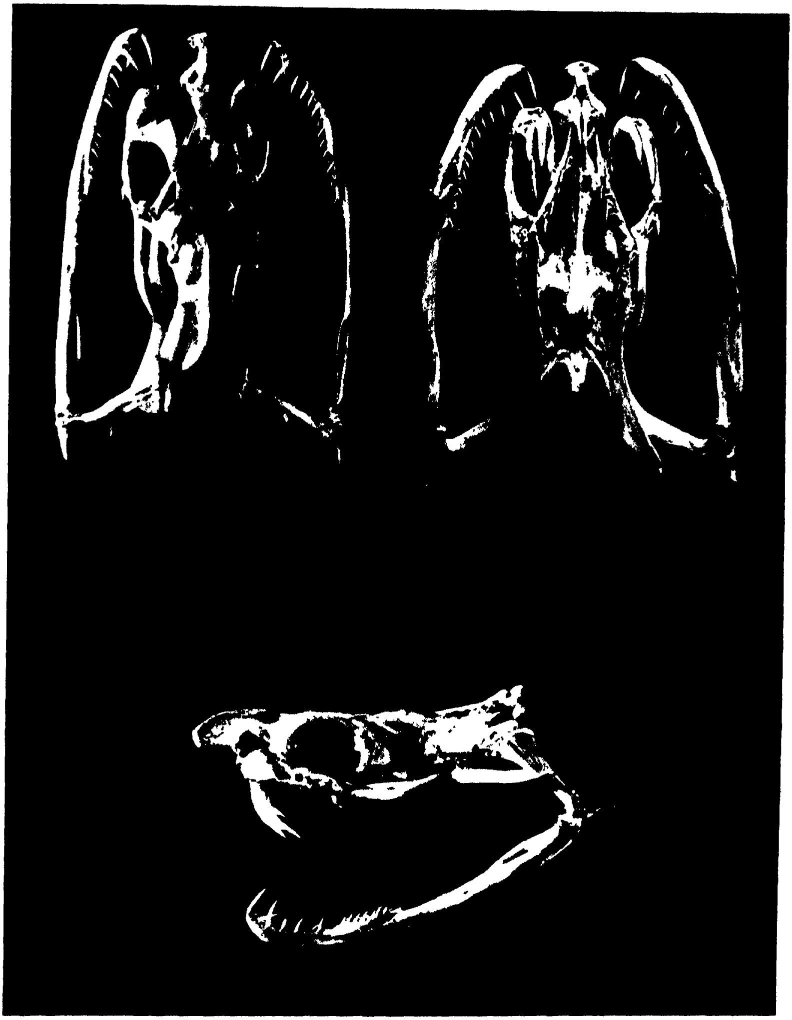
EXPLANATION OF PLATE VII.

Fig. 1. *Oxyuranus maclennani*, gen et sp. nov. Dorsal view of skull showing size and shape of plates, especially the parietal. Natural size.

,, 2. *Oxyuranus maclennani* Ventral view of skull showing palatines and maxillary bones. Natural size.

,, 3. *Oxyuranus maclennani.* Lateral view of skull showing fangs, single maxillary tooth, and enlarged anterior mandibular tooth. Natural size.

1



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G. C. CLUTTON, photos.

EXPLANATION OF PLATE VIII

Fig. 1. *Cassis bicarinata* Jonas from Lacépède Bay, S.A. Cox Collection.

„ 2. *Cassis fimbriata* Quoy & Gaimard from North West Australia. Helms Collection.

E. A. BRADFORD, photos.

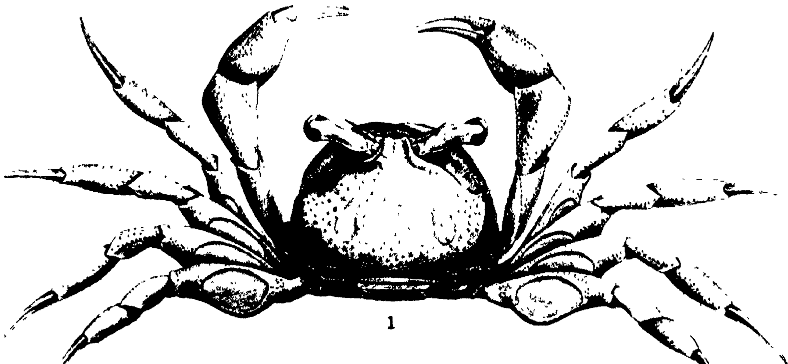
EXPLANATION OF PLATE IX.

Fig. 1 *Scopimera inflata* A. M. Edwards, male specimen 9 mm. wide, from Finches Bay, near Cooktown, North Queensland.

„ 2. Right chela of same specimen.

„ 3. *Atya striolata*, sp. nov. Holotype, 44 mm. long, from Norton's Basin, Nepean River, New South Wales. The third to fifth periopods are wanting in the holotype, and have been drawn from a somewhat smaller paratype.

„ 4. Dorsal view of the telson of the holotype, length 6 mm.



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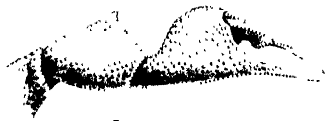

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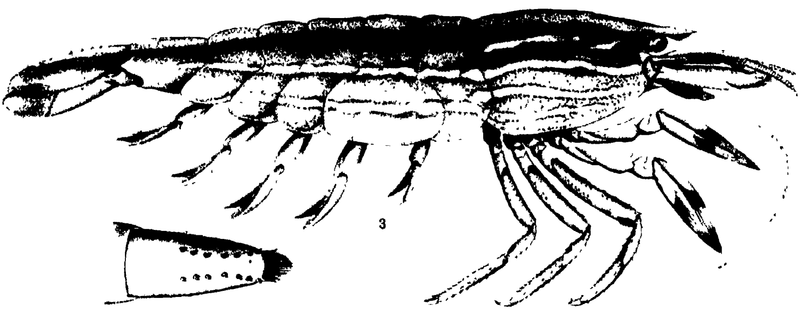

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J. R. KINGHORN (1, 2, 4),
A. R. McCULLOCH (3), del.

EXPLANATION OF PLATE X.

Fig. 1. Showing a few isolated burrows of *Scopimera inflata*.

Fingal Bay, near Port Stephens, New South Wales; January 28, 1920.

,, 2. Showing a section of the burrow of *Scopimera inflata* penetrating the firm dry sand to the moist sand below. Depth about 12 inches. The crab is shown at the base of the burrow, while some pellets are scattered around its entrance on the flat of the beach.

Fingal Bay, near Port Stephens, New South Wales; January 28, 1920.

,, 3. Collecting a series of *Atya striolata*, sp. nov. at the type locality, Norton's Basin, Nepean River, New South Wales; November, 1920.

1

2

3

H. FURST (1-2),
A. MUSGRAVE (3), photos.

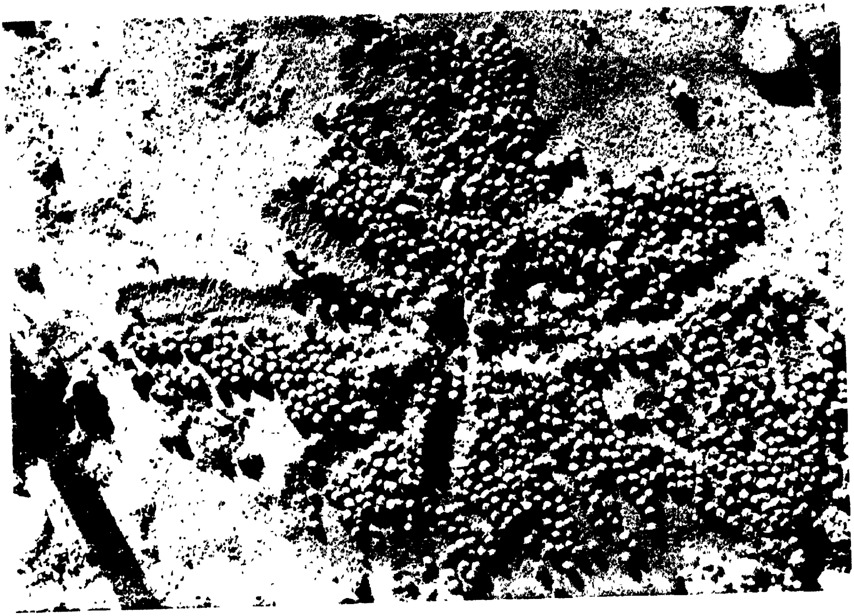
EXPLANATION OF PLATE XI.

Fig. 1. Burrow and pellets of *Scopimera inflata*, showing the radiating trenches excavated for food, and the sifted pellets arranged behind them. The large and irregularly-shaped sand pellets are those carried out by the crab while excavating its burrow.

Fingal Bay, near Port Stephens, New South Wales; January 28, 1920.

„ 2. Burrow and sand pellets of *Scopimera inflata;* illustrating the large number of pellets formed by a single crab.

Fingal Bay, near Port Stephens, New South Wales; January 28, 1920.



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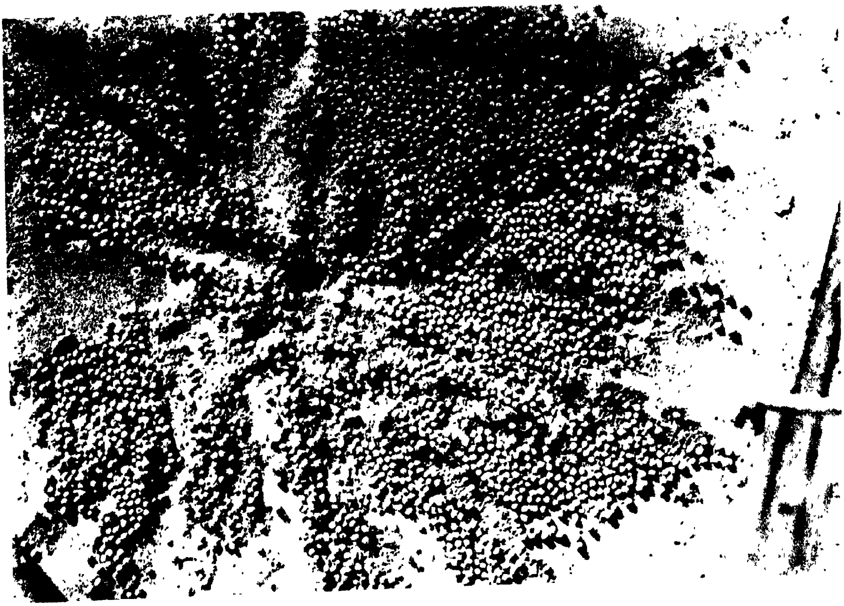

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H. FURST, photos.

OCCASIONAL NOTES ON AUSTRALIAN AMPHIPODA.

By

CHAS. CHILTON, M.A., D.Sc., F.L.S., C.M.Z.S.

(Professor of Biology, Canterbury College, New Zealand).

(Figures 1-5.)

Nos. 1 to 9.

During the last few years I have received from the Australian Museum and from other sources numerous specimens of Australian Amphipoda. The examination of these has brought to light many facts which seem worthy of publication, and it is proposed to give these in a series of papers as opportunity offers. In submitting the first of these papers I desire to express my grateful thanks to Dr. C. Anderson, Director of the Australian Museum, to Mr. Charles Hedley and to several members of the staff for the opportunity of examining and describing many of the species dealt with.

No. 1.

A New Australian Species of *Niphargus*.

In 1893 Mr. G. M. Thomson described two species of *Niphargus* from the fresh waters of Tasmania, *viz.*, *N. montanus* and *N. mortoni*. The latter species is retained under the genus *Niphargus* by Stebbing in 1910, but the former is placed under *Neoniphargus* Stebbing to which Stebbing also assigns two species described by Sayce, *viz.*: *N. spenceri* and *N. fultoni*. Another species described by Sayce, *N. pulchellus* is also kept under *Niphargus* by Stebbing, and placed next to *N. mortoni*. The relationships of these species to one another and to the species of *Gammarus* described from Australia by Sayce and Geoffrey Smith will afford interesting work for future students of the Amphipoda.

In the meantime I am describing another new species of *Niphargus*. It differs considerably from those mentioned above, and comes close to species recently described from Chilka Lake, India, and from the Philippine Islands. These three species differ from the characters of *Niphargus* in one or two important characters and appear to belong to a special section of the genus which will probably have to be made into a separate genus. At present, however, I leave them under *Niphargus* as a matter of convenience. The following specific diagnosis may be given:—

NIPHARGUS AUSTRALIENSIS *sp. nov.*

Very near to *N. chilkensis*. Eye not visible. Upper antenna with the first and second joints subequal, elongate, first much stouter than the second, third short, about one-third the length of the second, secondary appendage small, of two joints. Lower antenna with the flagellum half as long as the last joint of the peduncle and formed of a number of joints fused together, and two small separate joints at the end. First gnathopod with the posterior margin of the merus forming a rounded lobe covered with minute setæ and bearing a few long hairs; the carpus much longer than the propod, posterior margin and inner surface nearly covered with transverse rows of long fine setules; propod narrow at base, expanding distally, palm evenly convex, defined by a row of six or seven short stout setules. Second gnathopod much larger than the first, propod large, more than twice as long as the carpus, anterior margin regularly convex, palm occupying about two-thirds the posterior margin, defined by a distinct tooth, around which arise numerous fine setæ, thence for more than half the length of the palm concave, followed by irregularities up to the base of the finger; finger strongly curved, inner margin evenly concave. Fifth paræopod with the basal joint very large and greatly expanded; merus widening posteriorly so as to form a rounded lobe bearing five stout setules and some fine hairs, its anterior margin fringed with long fine hairs.

Length, about 10 mm.

Locality.—South-West Rocks, Trial Bay, New South Wales.

Remarks.—Of this species I have unfortunately only one specimen, probably a male, perhaps not quite fully developed. The resemblance to *N. chilkensis*, from Chilka Lake, East Coast of Bengal,[1] in nearly all characters except the second gnathopod is very striking and it is quite possible that further specimens may be found bridging over the differences between the two forms. Dr. C. Anderson, Director of the Australian Museum, informs me that the specimen was collected in a tidal lagoon in the S.W. creek which is one of the small outlets of the Macleay River, Trial Bay, the spot where the specimen was secured being about four hundred yards from the sea. Apparently the conditions under which this species was living are not unlikely those of Chilka Lake.[2] Another species belonging to the same section of the genus occurs in the underground waters of the Philippine Islands.[3] The occurrence of three closely allied species of the genus *Niphargus* at Chilka Lake, India, in underground waters of the Philippine Islands and in a tidal bay in New South Wales is of considerable importance from the point of view of zoogeographical distribution.

[1] Chilton—Indian Museum Memoirs, v, 1921, p. 531.

[2] The branchiæ, as shown in fig. 1D, bear numerous circular markings each with a small crescentic mark. These are apparently cysts or egg-cases of some organism adhering to the branchiæ, but I have not been able to identitfy them.

[3] Chilton—Philippine Journal of Science, xvii, 1920, p. 515.

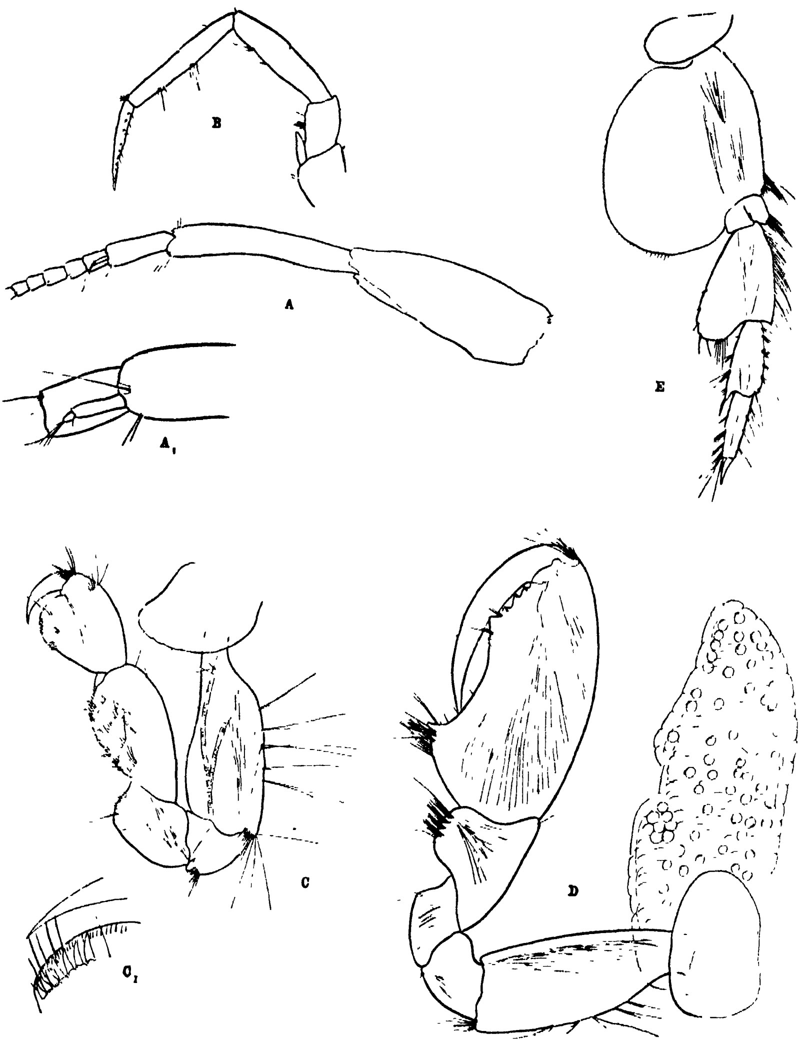

Fig. 1. *Niphargus australiensis* sp. nov.

A. Basal portion of first antenna.

A_1. Portion of same more highly magnified to show the accessory flagellum.

B. Second antenna.

C. First gnathopod.

C_1. End of palm and finger, more highly magnified.

D. Second gnathopod.

E. Fifth peræopod.

No. 2. Two Australian Species of *Amphilochus*.

I am recording the two species mentioned below under the name *Amphilochus*, although each differs from the generic description as given by Stebbing[4] in one point, that is to say, in the possession of a well developed molar tubercle to the mandibles. The first species agrees so entirely with the description of the European specimens of *A. neapolitanus*, Della Valle, in all other respects that it must, I think, be referred to this species. The second species, *A. squamosus* G. M. Thomson, differs from the generic description also in the possession of a minute accessory appendage on the first antenna. It has been described by Chevreux under the name *Gitanopsis antarctica*, but as the specimen examined and described by Stebbing (under the name *A. marionis*) apparently had the molar tubercle of the mandible not so well developed as in the specimens I have examined, it may, I think, remain under the genus *Amphilochus*.

The species of *Amphilochus*, *Amphilochoides*, *Gitana* and *Gitanopsis* are all small and the generic characters depend mainly on small differences in the mouth parts which can be found out only by dissection, and it is doubtful if the genera can be maintained as distinct. Certainly the Australian specimens of *A. neapolitanus* should, by the possession of the well-developed molar tubercle of the mandible, be placed under *Gitanopsis* while the other characters would necessitate their being placed under *Amphilochus*.

Amphilochus neapolitanus *Della Valle*.

Amphilochus neapolitanus, Stebbing, K. Pr. Akademie Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 150.

Amphilochus neapolitanus, Chevreux, Soc. Zool. France, xxiii, 1911, p. 191.

I have two specimens from Coogee, New South Wales, sent by the Australian Museum, which on dissection appear to belong to this species; the gnathopoda agree precisely with the figures given by Della Valle, in the second the process from the carpus extending quite to the end of the palm and overlapping it with the slightly curved point. Both these specimens are small, one about 3 mm. long, the other not much more than half that size. I have other specimens from Port Jackson sent to me by Professor W. A. Haswell in 1918, and the first of these dissected and examined proved to be quite the same as the Coogee specimens. In another, apparently similar in all other respects, the process from the carpus in the second gnathopod did not quite reach the palm and did not end in a curved point. Walker has united his own species, *A. melanops* with *A. brunneus* Della Valle and is of opinion that both are to be considered as

[4] Stebbing—K. Pr. Akad. Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 149.

synonyms of *A. neapolitanus*. In 1911 Chevreux recorded the two last named species from various localities in the Mediterranean, Algeria, etc., but found that the length of the carpal process of the posterior gnathopod was quite constant in each species and that in one it overlapped the palm even in small specimens measuring 1 mm. in length. These he therefore names *A. neapolitanus*, and considers the others in which the carpal process, though varying in length, does not reach to the palm, as *A. brunneus*. The two species, *A. neapolitanus* and *A. brunneus*, were originally described by Della Valle from the Gulf of Naples and, though the differences between them are very slight, he considered them as distinct species.

I have examined specimens of *Amphilochus* from Chilka Lake and referred them to *A. brunneus* as in none of those that I examined did the carpal process reach quite to the palm.[5]

There is, however, another character to be considered. In the genus *Amphilochus* as defined by Stebbing,[6] the mandible has the molar process feeble; it is figured by Della Valle as somewhat conical in shape and quite small for *A. neapolitanus* and is similarly described for *A. brunneus*. In the specimens from Coogee and from Port Jackson which I have examined, it is, however, by no means feeble, but well developed and strong, resembling the process figured by Sars for *Gitanopsis bispinosa*. This led me to re-examine the Chilka Lake specimens with special reference to this point, and I find that although in all other respects they agree with the characters of *Amphilochus brunneus* as given by Della Valle they have the molar process of the mandible well developed, and almost if not quite as large as in the Australian specimens.

Walker in 1904 doubtfully identified a specimen from Ceylon as *Amphilochus neapolitanus* Della Valle. He had only one young and imperfect specimen, 1.5 mm. long, and he gave no description either of the gnathopods or of the molar of the mandibles.

The genus *Gitanopsis* is distinguished from *Amphilochus* mainly owing to the well-developed molar. In the New Zealand specimens which have hitherto been referred to *A. squamosus* G. M. Thomson the molar is large and well developed. This species has been re-described by Chevreux from Antarctic specimens as *Gitanopsis antarctica*. On the other hand in *Amphilochus marionis* Stebbing, which I have considered to be the same as *A. squamosus* G. M. Thomson, the molar is apparently not so well developed, for Stebbing[7] says: "The molar tubercle (not shown in the figures *m*, *m*) is conical, scarcely if at all dentate."

[5] Chilton—Indian Museum Memoirs, v, 1921, p. 524.

[6] Stebbing—K. Pr. Akad. Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 149.

[7] Stebbing—Challenger Report, Zoology, xxix, 1888, p. 744.

I have been able to examine specimens of *Gitanopsis pusilla* Barnard (Ann. S. African Mus. xv, p. 145) from South Africa through the kindness of Mr. Barnard and cannot distinguish them from the Australian specimens I am referring to *Amphilochus neapolitanus*. Mr. Barnard says it is distinguished from all other species by the very short telson. In the specimen I have examined the telson is longer in proportion to the third uropod than is shown in his figure and fully as long as in the Australian specimens, and even if there is a slight difference in the length of the telson, this seems to me to be more than counterbalanced by the very close resemblance in the other characters.

It appears from the facts mentioned above that not only do specimens vary in the length of the carpal process of the second gnathopod, but that specimens which agree in this character may differ from one another in the development of the molar process of the mandible. Apparently it is not a character varying with age, for all the numerous specimens that I have examined from Australia and New Zealand have the molar well developed, while in all the European specimens that have been referred to *Amphilochus* the molar is feeble. In face of these facts the difficulty of classifying these small animals is increased and it seems doubtful whether the distinction between the different genera can be maintained. In the meantime I am recording the specimens from Coogee and Port Jackson under the name *Amphilochus neapolitanus* Della Valle; the species was not previously known from Australia.

AMPHILOCHUS SQUAMOSUS *G. M. Thomson.*

Amphilochus squamosus, Thomson, Ann. Mag. Nat. Hist., (5), vi, 1880, p. 4, pl. 1, fig. 4, 4a.

Amphilochus squamosus, Chilton, Trans. Roy. Soc. Edin., xlviii, 1912, p. 479.

Amphilochus marionis, Stebbing, Challenger Report, Zoology, xxix, 1888, p. 743, pl. 38; K. Pr. Akademie Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 151; Austr. Museum Memoir iv, 1910, p. 577.

Gitanopsis antarctica, Chevreux, 2me Expéd. Ant. Fr., 1912, p. 104.

This species was originally described by Mr. Thomson from New Zealand specimens, and probably his figure was taken from an immature specimen. In 1888 Stebbing described *A. marionis* from Marion Island and apparently had only "one specimen, a female with eggs." In 1912 I examined specimens obtained by the "Scotia" from the South Orkney Islands and came to the conclusion that they were the same as the New Zealand species, and I united *A. marionis* with it owing to the very close resemblance. In all the New Zealand and South Orkney specimens that I have examined the molar of the mandible is strong and fully developed. Apparently as stated above it is not so well developed in the specimen from Marion Island examined by Stebbing, so that here as in *A. neapolitanus* we apparently have specimens differing somewhat in the molar but quite similar in all other characters. In 1913 Chevreux described the species

Gitanopsis antarctica from Antarctic regions which is, I think, quite identical with *A. squamosus*. It has the molar well developed. In this identification I have had the advantage of examining a specimen of his species kindly sent to me by M. Chevreux. In 1910 Stebbing recorded *A. marionis* from Australian seas, but gave no further information about the molar of the mandible. In connection with Walker's suggestion that *A. marionis* might possibly be a synonym of *A. neapolitanus* Stebbing says that the telson of *A. marionis* is particularly short compared with most other species. An examination of numerous New Zealand specimens seems to show, however, that the telson may be considerably longer and narrower than that figured by Stebbing for *A. marionis*, and in one specimen it has at the extremity two minute crenulations just as Chevreux figures for *Gitanopsis antarctica*. Though the shape of the telson thus appears to be of little value as a specific distinction, *A. squamosus* differs markedly from *A. neapolitanus* in the character of the carpal lobe in the second gnathopod, and must be regarded as a distinct species. In the gnathopoda and in most of the other appendages it shows a close resemblance to *A. manudens* Bete, but in that species the mandibular molar is feeble, there is no accessory flagellum and the propod is produced beyond the base of the finger into an acute tooth.

Amphilochus squamosus is widely distributed in Subantarctic seas, having been recorded from New Zealand, Australia, Peterman Island, South Orkneys and Marion Island.

No. 3. THE AUSTRALIAN SPECIES OF *Leucothoe* AND *Paraleucothoe*

In 1880 Haswell described *Leucothoe commensalis* from specimens obtained in Port Jackson found in ascidians, etc., also *L. diemenensis* and *L. gracilis* from Tasmania. In 1884 Miers[8] added *L. brevidigitata* from Torres Strait but regarded *L. commensalis* as a variety of *L. spinicarpa* (Abildg.), the species common in northern seas. In 1893 in revising some of the Amphipoda of Australia Haswell mentions this and adds that "*L. gracilis* and *L. diemenensis* are to be regarded as marked varieties of the same" (*i.e.*, of *L. spinicarpa*). In 1888 Stebbing described *L. flindersi* also from Torres Strait and *L. tridens* from New Zealand. In 1906 in "Das Tierreich" Amphipoda he gave *L. commensalis* as a separate species "close to *L. spinicarpa*." *L. diemenensis* and *L. gracilis* were given by him as being scarcely distinguishable from *L. commensalis*. He united *L. flindersi* with *L. brevidigitata* Miers, but keeps this, *L. traillii* G. M. Thomson (1882) from New Zealand, and *L. tridens* as separate species. In 1912 I identified *L. tridens* Stebbing with *L. traillii* G. M. Thomson and regarded both of these as synonyms of *L. spinicarpa* to which species I also referred *L. antarctica* Pfeffer from South Georgia (1888).

[8] Miers—Report H.M.S. "Alert," 1881 2 (1884), p. 313.

In his report on the Amphipoda of the "Thetis" Expedition Stebbing[9] still retains *L. commensalis* Haswell under that name but states: "It is perhaps only a matter of taste or convenience whether this should be taken as a distinct species or as a variety of *L. spinicarpa* Abildgaard." He mentions one or two points in which the second gnathopod differs slightly from Sars' figure of the European form, *e.g.*, the palm being more strongly tuberculated as stated in Haswell's description. He adds that the postero-lateral angle of the third pleon segment is without sinus, but that a specimen sent to him some years previously under this name had the sinus and so had the "Thetis" specimen taken off Manning River (see below under "*L. assimilis*"). In the same report (p. 636) after giving *L. commensalis*, *L. brevidigitata*, *L. diemenensis* and *L. gracilis* in his list he adds—"It is unlikely that these names represent four distinct species. Dr. Della Valle (1893) may be right in practically uniting them all with *Leucothoe spinicarpa* (Abildgaard), which A. O. Walker (1909) declares to be cosmopolitan."

In 1880 Haswell had described *L. novæ-hollandiæ* from Port Jackson, a species differing from the species of *Leucothœ* particularly in the shape of the first gnathopod. In 1899 Stebbing established the genus *Paraleucothoe* for this species which is accordingly given in "Das Tierreich" Amphipoda as *Paraleucothoe novæ-hollandiæ* with additional information as to the mouth parts, etc., presumably based on specimens examined by Stebbing.

Some considerable time ago, in order to feel more confidence about the various identifications above referred to, I endeavoured to get co-types or named specimens of Haswell's species, and from the Macleay Museum, University of Sydney, I received the following tubes, which I have examined with the result mentioned in each case:—

Tube No. 1—labelled "*Leucothoe novæ-hollandiæ* Port Jackson."

This contains male and female specimens of this species, now known as *Paraleucothœ novæ-hollandiæ*, and also one specimen of *Leucothœ spinicarpa* (Abildg.).

" No. 2—labelled "*Leucothoe commensalis* Haswell, Port Jackson."

These appear to me to be all *L. spinicarpa*, no appreciable difference being noted, although, as pointed out by Stebbing, the teeth, etc., on the palm of the second gnathopod vary and are not precisely the same as those in the individuals figured by Sars.

" No. 3—labelled "*L. gracilis* Haswell, Tasmania."

Of this there is only one specimen, badly preserved and imperfect, but I see no reason for separating it from *L. spinicarpa* (Abildg.).

[9] Stebbing—Australian Museum Memoir iv, 1910, p. 580.

Tube No. 4—labelled "*Leucothoe sp. ?*" from Tasmania.

This also seems to me to belong to *L. spinicarpa* (Abildg.).

„ No. 5—labelled "*Leucothoe assimilis*, Port Denison."

Of this there is a single specimen, imperfect and poorly preserved. In the gnathopods and antennæ, etc., it seems to agree well with *L. spinicarpa*, but the third pleon segment has a sinus above the subacute postero-lateral angle, somewhat similar to that described by Stebbing for *L. lilljeborgii* Boeck, and figured by Sars for this species under the name *L. imparicornis* Norman. The gnathopod, however, is much more like that of *L. spinicarpa* than the figure given by Sars for *L. imparicornis* Norman, which gives one the impression of being taken from an immature specimen. The name "*Leucothoe assimilis*" attached to the Macleay Museum specimen is, I presume, a MS. Museum name.

„ No. 6—labelled "Port Jackson."

Most of these unnamed specimens prove to be *L. spinicarpa*, but there are a few of *Paraleucothoe novæ-hollandiæ* which have been included among them.

I have also a tube sent from the Australian Museum labelled "*Leucothoe spinicarpa* Haswell, Port Stephens, Reg. No. P.3472." These also prove to be *L. spinicarpa* as named.

There seems to be considerable variation in the stoutness of the antennæ. I have one mounted specimen from Spencer Gulf, South Australia, in which the peduncles are specially stout and the flagella very short, being very similar to those of *L. tridens* as figured by Stebbing; in two other specimens, however, taken at the same time and place, the flagella are longer and the peduncles more slender and approaching closely to the typical form.

I therefore consider that all the forms mentioned above, with the exception of *Leucothoe novæ-hollandiæ* Haswell and *L. brevidigitata* Miers are to be looked upon as belonging to the widely distributed *L. spinicarpa* (Abildg.). In my report[10] on the "Endeavour" Amphipoda, I also added to the list of synonyms *L. miersi* Stebbing, from South Africa, as Barnard had already done in 1916. Barnard suggests that *L. brevidigitata* from Torres Strait is another possible synonym and this is probably the case though the first gnathopod as drawn by Stebbing (under the name *L. flindersi*) bears some resemblance to that of *Paraleucothoe novæ-hollandiæ* (Haswell).

The synonyms important for the Australian student may therefore be given as follows:—

[10] Chilton—Biological Results of the F.I.S. "Endeavour" 1909-14, v, 2, 1921, p. 59.

LEUCOTHOE SPINICARPA (*Abildg.*).

Leucothoe spinicarpa Stebbing, K. Pr. Akademie, Berlin, Das Tierreich, Lief. 21, 1906, p. 165; Walker, Nat. Ant. Arct. Exped., 1901-04, iii, Amphipoda, 1907, p. 18.

L. commensalis, *L. diemenensis* and *L. gracilis*, Haswell, P.L.S. N.S.W., iv, 1879, pp. 261-263.

L. traillii, *L. miersi*, *L. commensalis*, *L. tridens* and *L. brevidigitata*, Stebbing, K. Pr. Akademie, Berlin, Das Tierreich, Lief. 21, 1906, pp. 164-167.

L. antarctica, Pfeffer, Jahrb. Wiss. Anstalten zu Hamburg, v, 1888, p. 128.

L. spinicarpa, Chilton, Trans. Roy. Soc. Edinb., xlviii, 1912, p. 478; Indian Museum Memoirs, v, 1921, p. 59; Biological Results of the F.I.S. "Endeavour," 1909-14, v, 2, 1921, p. 59; Barnard, Ann. S. African Museum, xv, 1916, p. 148.

The species, as thus understood, is found in all seas. I have seen specimens from many localities on the east and south coasts of Australia, and from Tasmania and New Zealand. These differ in size, the largest being about 18 mm. in length, and exhibit variations in some other characters, but after comparison with European specimens I have not been able to find constant characters by which to subdivide them into different species.

I have recently examined some specimens from the Indian Museum collected at the Andaman Islands from the branchial sac of an Ascidian. These are small, only about 5 mm. long and in the gnathopods and other characters they agree with the figures given by Sars for *L. spinicarpa* even more closely than the Australian specimens do.

A specimen received from the Hawaiian Islands is very similar to those from the Andaman Islands and corresponds well with Sars' figures.

The fact that specimens have been found in Australia differing apparently from the others only in the presence of a sinus above the subacute postero-lateral angle of the third pleon segment and that a similar form (*L. lilljeborgii* Boeck) occurs in Europe along with the typical form seem to show that there is a closer connection between the forms with the sinus and the typical forms than is indicated by ranking them as two distinct species.

PARALEUCOTHOE NOVÆ-HOLLANDIÆ (*Haswell*).

Paraleucothoe novæ-hollandiæ Haswell, P.L.S. N.S.W., iv, 1879, p. 329; Stebbing, K. Pr. Akademie Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 169.

I give figures of the first and second gnathopoda of the male which will sufficiently indicate their structure without a lengthy description. In the female the first gnathopod differs considerably from that of the male, having the basal joint somewhat widened, the carpus oval and less truncate at the extremity and the propod less abnormal in shape.

Specimens belonging to this species were taken by Dr. E. Mjöberg in Australian seas and will be more fully described in my report on the Amphipoda collected by him. (Report not yet published.)

This species is known from Port Jackson and from the north-west coast of Australia.

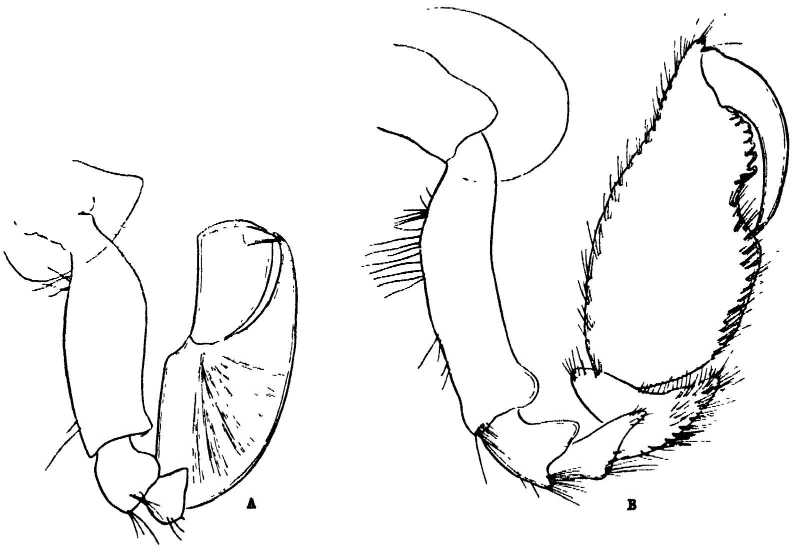

Fig. 2. *Paraleucothoe novae-hollandiae.*
A. First gnathopod of male.
B. Second gnathopod of male.

No. 4. Unusual Occurrence of *Talitrus sylvaticus* Haswell.

In November, 1921, a tube of dried specimens of this species was sent to me by the Australian Museum with the following printed note:

> "Mr. G. H. Halligan exhibited, in quantity, examples of an undetermined amphipod, which after rain, and with the wind in a certain direction, were to be found, regularly, strewn over the floor of the porch of his house at Hunter's Hill. As his garden was kept in order, and there was nothing out of the ordinary in the way of cover for the animals, he was at a loss to know how they came to be so abundant; and he wished for an explanation of their occurrence."—P.L.S. N.S.W., xxxix., 1914, p. 162.

I have mounted three specimens and although they were dry and imperfect they shew sufficient for identification and are certainly to be referred to *Talitrus sylvaticus* Haswell. In all three the third pleopod is quite small with the branches vestigial.

The species is widely distributed in many parts of Australia, and the animals are doubtless numerous in the garden and the combined wind and rain caused them to be driven to the porch. Perhaps the rain made their ordinary resting place too wet and in hopping out the wind carried them to the porch on the floor of which they could not conceal themselves. In the same way in Christchurch, New Zealand, the common earthworm comes to the surface in great numbers after heavy rain and is very evident on the asphalt paths while on lawns, etc., though equally abundant it is more easily concealed.

The allied New Zealand species *Parorchestia sylvicola*, may occur in numbers of gardens and some years ago Dr. F. W. Hilgendorf sent me specimens from a garden at Waihola, Otago, where they were eating into the strawberries.

No. 5. The Australian Freshwater Species of *Atyloides.*

The late Mr. Sayce described two species of freshwater Amphipods from Victoria which he referred to the genus *Atyloides, viz.*: *Atyloides gabrieli*[11] and *Atyloides fontana*[12]. The first species was obtained by Sayce from several localities in Victoria, in some cases at an altitude of about 1,500 ft.; the second species, *A. fontana,* was obtained from Wood's Point, at an altitude of about 3,000 ft.

I have received from Miss Marguerite Henry, B.Sc., Macleay Research Scholar, from a stream at the Jenolan Caves, specimens which prove to belong to *A. fontana*. These agree well with Sayce's description and, as he points out, they differ from *A. gabrieli* in the possession of numerous setæ on the inner lobe of the first maxilla, in the shape of the lobe on the carpus of the second gnathopod and in a few other details. I have also specimens of *A. gabrieli* sent to me years ago by Mr. Sayce which enable me to confirm the account he gives as to the differences between the two species. The difference between the two species in the inner lobe of the first maxilla is perhaps the most important one and has a very distinct bearing on the reliability of the characters used for distinguishing *Atyloides* and other allied genera and will be referred to later on.

In 1909 I described under the name of *Atyloides aucklandicus* specimens from fresh waters in the Lord Auckland Islands to the south of New Zealand referring them to the species which had received this name from Mr. A. O. Walker. I was at the time a little doubtful whether it was congeneric with the Australian species or not, but a comparison of the actual specimens has now convinced me that it is; it

[11] Sayce—Proc. Royal Soc. Victoria, xiii, 1901, p. 230.
[12] Sayce—loc. cit., xv, 1902, p. 49.

can readily be distinguished, however, by the shorter and stouter gnathopods, and by the less developed lobes on their carpal joints and also by the shape of the telson which is somewhat ovoid, narrowing distally.

Dr. Tattersall[13] has recently described another freshwater species from Japan, which he refers to the genus *Atyloides*, *viz.*: *Atyloides japonica*, his specimens being obtained from the small torrent in hills behind Komatsu, on Lake Biwa.

The description and figures that he gives show that his Japan specimens undoubtedly belong to the same genus as the Australian species, and that it is closely allied to *A. fontana* Sayce. The occurrence of allied freshwater species of this genus in New Zealand, Australia and Japan is extremely interesting from the point of view of geographical distribution, and as Dr. Tattersall points out, finds a parallel in the genus *Paratya* among the Macrura and in other cases.

Dr. Tattersall has called attention to the presence of a number of finger-like processes on the sternum on certain of the thoracic segments in his species and compares them with similar processes found by Sars in *Gammarus pulex* and *Pontoporeia affinis*, by Smith in *Pontoporeia hoyi*, by Shoemaker in *Synurella johanseni* and by myself in *Gammarus barringtonensis*. I find that these processes are present also in both the species described by Sayce and in *Atyloides aucklandicus*. In the latter species, however, they are slightly broader than in the other two, and appear to be more similar to the ordinary branchia. What their function may be is uncertain, but apparently they have some connection with the freshwater habitat of the species in question. Tattersall says:—"They are quite distinct from the accessory branchial vesicles which I have described below in *Gammarus annandalei*, which are definitely additional processes on the outside of the branchial lamellae themselves." Similar processes are present in some freshwater species of *Hyalella* in South America, *viz.*: *H. jelskii*, *H. dybowskii* and *H. lubomirskii*. All three are found at altitudes of more than 2,000 metres and some of the other species in which these processes are found also live far above the sea-level; possibly the altitude may be one of the determining factors in their development.

The genus *Atyloides* should probably, as Tattersall points out, be considered a synonym of *Paramœra* Miers and therefore dropped and a new genus established for the freshwater species, but as there is much confusion in connection with these two and other allied genera it is well to retain *Atyloides* till some comprehensive revision can be made. In the diagnoses given by Stebbing of *Atyloides* and *Paramœra* the inner plate of the first maxilla is said to bear many setæ. This is true for *A. fontana* and *A. aucklandicus*, but in *A. gabrieli* there are only three, though that species is certainly congeneric with *A. fontana*. Evidently this character is not of generic importance in this group.

[13] Tattersall—Mem. Asiatic Society of Bengal, vi, 1922, p. 442.

No. 6. EURYSTHEUS THOMSONI (*Stebbing*).

Eurystheus thomsoni Stebbing, Austr. Museum Memoir iv, 1910, p. 614.

Eurystheus thomsoni Chilton, Biological Results F.I.S. "Endeavour," 1909-14, v, 2, 1921, p. 81.

The male of this species has been described by Stebbing and myself in the papers quoted above, and we have both pointed out that in the specimens examined the second gnathopoda were unequal, the greatly enlarged form being found on one side only. I stated that the male was not very dissimilar in the second gnathopod from *E. crassipes*

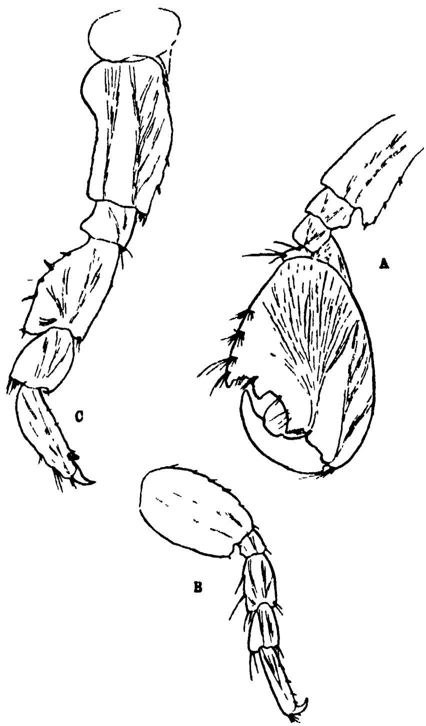

Fig. 3. *Eurystheus thomsoni* (Stebbing), male.
A. second gnathopod.
B. third peræopod.
C. fourth peræopod.
(All the figures magnified equally.)

(Haswell), though the fourth peræopod did not appear to be greatly broadened as in that species. I have, however, since received a male specimen collected at Balmoral, Port Jackson, by Mr. T. Whitelegge, and in this the fourth peræopod is greatly enlarged, being very large in comparison with the third and the fifth. I give figures of the

third and fourth peræopods and also one of the second gnathopod since the dactyl bears two projections on its concave margin instead of one only, as in the specimen figured in the report on the "Endeavour" Amphipoda. I presume that the male now being described is more mature than the two previously examined by Stebbing and myself and that we have here another example showing that the different secondary sexual characters of the male may be developed at different ages, *e.g.*, the greatly enlarged fourth peræopods being developed only at a later stage than the characteristic second gnathopods.

It is evident from what has been stated above that *E. thomsoni* comes still closer to *E. crassipes* than I considered it to be in 1921.

No. 7. CERADOCUS RUBROMACULATUS *Stimpson* and MAERA RAMSAYI *Haswell.*

In 1885 Haswell[14] united *Mæra spinosa* Haswell and *M. ramsayi* Haswell with *Ceradocus rubromaculatus* (Stimpson) saying that these forms were separated mainly by the shape of the second gnathopoda and that he found "on examining a series of specimens, a perfect series of gradations in this respect from the form figured by Stimpson to typical forms of *M. spinosa* and *M. ramsayi*." He added that *Macra festiva* Chilton also belonged to the very variable species *C. rubromaculatus*.

Stebbing adopted this view in 1906, and in "Das Tierreich" Amphipoda *M. spinosa*, *M. ramsayi* and *M. festiva* are all given as synonyms of *C. rubromaculatus*. In his report on the "Thetis" Amphipoda [15], however, he changed his opinion and gives them all as separate species saying "the position of all three should rather be regarded as still doubtful."

The specimens from which *M. festiva* was originally described all lacked the terminal uropoda, and as I pointed out at the time[16], it was impossible to say whether the species was a *Macra* or a *Melita*. Many years afterwards I obtained specimens from Auckland, New Zealand, with the terminal uropoda still attached, and was able to say that the species was really a *Melita* and therefore quite distinct from *C. rumbromaculatus*.

From the comparison of the description and figures and of specimens, I think that *M. spinosa* Haswell is certainly to be regarded as a synonym of *C. rubromaculatus*. Until recently, however, I had not seen any specimens that I could identify with *M. ramsayi* as described by Haswell. I have now been able to examine specimens from Port Jackson that agree closely with Haswell's original description. In general form, in the teeth on the posterior margin of the pleon segments and in the terminal uropoda they are very similar to *C. rubromaculatus*. The second gnathopoda are, however, very large

[14] Haswell—P.L.S. N.S.W., x, 1885, p. 105.
[15] Stebbing—Austr. Museum Memoir iv, 1910, pp. 642-3.
[16] Chilton—P.L.S. N.S.W., ix, 1885, p. 1037.

and massive, the "palm nearly transverse, defined by a strong, pointed, slightly curved tooth and armed with three other large compressed teeth." This differs considerably from the oblique palm usually found in *C. rubromaculatus*, and although it is true that the armature of the palm in this species is very variable, I have not seen forms quite intermediate between the usual one and that in *M. ramsayi*. Chevreux has described specimens of *C. rubromaculatus* from the Gambier Archipelago in which the palm was nearly transverse but the teeth on it are rather different from those of *M. ramsayi*. It matters little whether *M. ramsayi* is considered a form of *C. rubromaculatus* or a distinct species, but it is desirable that its distinctive gnathopod should be known, and I therefore give a figure taken from a Port Jackson specimen.

In the specimens of *C. ramsayi* that I have seen, the right and left second gnathopoda of the male are of unequal size; in Haswell's type specimen they were also unequal, as they frequently are in typical forms of *C. rubromaculatus* and in other species in which the gnathopoda are of large size.

C. ramsayi comes very close to *C. rubromaculatus* in the dentation of the terminal segments of the body, in the general characters of the appendages, and in the unsymmetrical second gnathopods, and as these appendages in the latter species show such great variation, I prefer to consider *C. ramsayi* as a well-marked variety of *C. rubromaculatus* rather than a separate species.

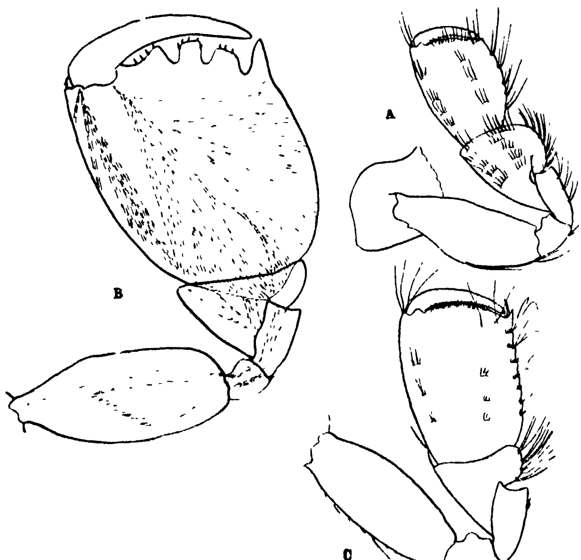

Fig. 4. *Ceradocus rubromaculatus* (Stimpson), *var. ramsayi*.

A. first gnathopod of male.
B. second gnathopod, the enlarged form from right side of body.
C. second gnathopod, from left side of same specimen.

No. 8. CHILTONIA AUSTRALIS (*Sayce*).

Hyallela australis Sayce, Proc. Roy. Soc. Victoria, xiii, 1900, pp. 226-230, pl. xxxvi.

Chiltonia australis Sayce, *loc. cit.*, vol. xv, 1902, p. 47.

I have one small male from Parramatta (freshwater), New South Wales, collected by Mr. W. M. Thomson, that evidently belongs to this species. It agrees in all points very closely with Sayce's description and figures. As Sayce has pointed out, this species differs from the generic description given by Stebbing in having the minute terminal uropods two-jointed, not one-jointed as in *C. mihiwaka* (Chilton) and *C. subtenuis* Sayce.

Specimens from Moss Vale sent by Miss Marguerite Henry, B.Sc., prove to belong to the same species. This species was previously known from several localities in Victoria and from Lake Petrarch, Tasmania. More recently, I have received specimens from Prof. W. A. Haswell collected at Berrima and Bowral, and from Miss Henry specimens from Epping and Melbourne in Victoria.

The genus *Chiltonia* is very close to *Hyalella* to which several freshwater species from South America belong, and the species *C. australis* is practically intermediate between the two. The existence of closely allied freshwater amphipods in Australia, New Zealand, the Subantarctic Islands of New Zealand and in South America is important zoogeographically.

No. 9. STENOTHOE VALIDA *Dana*.

In the seas around Australia and New Zealand there are occasionally found specimens of a species of *Stenothoe* that has not been very satisfactorily identified up to the present. I have long felt practically certain that it is the same as the form described by Dana under the name *Stenothoe validus*, the agreement in the different appendages being very close, as will be seen from the descriptions given later on. Dana's species was based on specimens obtained at Rio de Janeiro, but has long remained doubtful. This appears to be due to the fact that in his figure of the whole animal, Dana shows distinctly four side plates, the first one being moderately large and not concealed by the second, and that he both figured and described the basal joint of the third peræopod as being expanded in the same way as in the fourth and fifth. Apparently, however, in all the species referred to the genus *Stenothoe* by Stebbing in 1906, the first side plate is quite small and nearly completely covered by the second and the basal joint of the third peræopod is narrow. If Dana's description with regard to these two points is accurate, his species would therefore differ from all the others in the genus, though agreeing so very closely in other characters that it must be considered identical with one or more of them. I feel convinced, therefore, that Dana's description is erroneous and probably due to the artist's drawing these two structures to agree with the normal condition in other amphipods.

The further history of the specimens which I refer to Dana's species is as follows, and is given in some detail, as it will tend to confirm the results otherwise arrived at.

In 1880 Haswell described from New South Wales two species, *Montagua miersii* and *M. longicornis*, differing in the antennæ and gnathopoda; these two were united by Stebbing in 1906 as the female and male of a species of *Stenothoe*. In 1883 I obtained from Lyttelton, New Zealand, some small specimens which I identified with *Montagua miersii* Haswell, changing the generic name, however, to *Montaguana* as *Montagua* was preoccupied. These specimens were in all probability females or immature males of Haswell's species. At that time I had not seen the mature male. Later on, in 1892, I identified, with some slight doubt, further specimens I had obtained with *Stenothoe adhaerens* Stebbing described from two females taken by the "Challenger" off Cape Agulhas, South Africa; I described the male and pointed out that it agreed somewhat closely with that of *Stenothoe marina* (Spence Bate) from Europe and that *Montagua longicornis* Haswell was probably the same as my New Zealand specimens. In 1888 Della Valle united under the name *Stenothoe valida* Dana not only these but also several other specimens that had been assigned to this genus.

My specimens of the fully developed male agree closely (except as indicated above) with Dana's figures. The form he described as a female also closely resembles New Zealand specimens taken along with the male. In large specimens that I have dissected and mounted of the male, the mouth parts seem to be more or less atrophied and imperfect. This appears to be also the case with the maxilliped of the male figured by Dana, for this is drawn as smaller and with fewer setæ than the corresponding appendage in the specimen he calls the female —this seems an additional argument for referring the New Zealand specimens to Dana's species.

From Oterangi Bay, Cook Strait, New Zealand, I have various specimens collected by Professor H. B. Kirk, from among which I have mounted specimens of the adult male, the female and the form I consider an immature male. As these were all collected at the same time and place and show in other points close resemblance, they must, I think, all belong to the same species and be looked upon as representing different stages of the growth of the two sexes. From another locality in Cook Strait and from Lyttelton, New Zealand, I have specimens forming similar series; specimens recently received from the Australian Museum collected in Port Jackson, New South Wales, are quite the same as those from New Zealand seas.

In 1910 Walker[17] identified specimens from Peru with *S. assimilis* Chevreux, a species originally found at Monaco, and after pointing out that this species differs from *S. gallensis* Walker in the last joint of the third uropod of the male which is upturned, serrate and blunt in *S. gallensis* but straight, smooth and sharply pointed in *S. assimilis*, he adds:—

"Both these species are so closely allied to *S. valida* Dana, 1852, that but for the fact that he has figured the third peræopods with a wide basal joint instead of the narrow one of the above two species, *S. assimilis* and *S. gallensis*, they might both be referred to it, notwithstanding the trifling difference in the third uropods. I have a strong suspicion that if Dana's type-specimen could be discovered, it would be found that he had overlooked the difference in the form of the joints. *S. assimilis* would then be a synonym of *S. valida*."

Chevreux had described *S. assimilis* in 1908 and compared it with *S. valida*, *S. dollfusi*, etc., but then kept it distinct from *S. valida* (Dana).[18] Later in 1913 Chevreux[19] for reasons stated identified *S. assimilis* with *S. valida*, having been able to examine specimens from Brazil which he considers to be *S. valida*.

I had written the first portion of this paper before I came across these references to Walker and Chevreux, but have allowed it to stand in order to show that Walker, Chevreux and myself all agree at the incorrectness of Dana's original figures in the points referred to.

Before I came to this conclusion I had mounted about eighteen specimens of various sizes and of both male and female from different localities in New Zealand, and with the help of Miss Herriott, assistant at the Biological Laboratory, had examined them with regard to the side plates, mouth parts, and the third peræopod. I found that the first side plate was either very small or absent altogether, and that in all cases the basal joint of the third peræopod was narrow. It is to be remembered that in his original description of *S. gallensis* Walker described the basal joint of the third peræopod as being broadened, but afterwards corrected this statement, and that Chevreux has pointed out that by a slip in Della Valle's description, the fifth and sixth pairs of legs were referred to in place of the sixth and seventh. In view of these and similar facts, it is evident that too great reliance cannot be placed on published descriptions, and that the actual specimens should be examined and compared wherever possible.

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[17] Walker—Proc. U.S. Nat. Mus., xxxviii, 1910, p. 621.
[18] Chevreux—Bull. Inst. Oceanog., 113, 1908.
[19] Chevreux—loc. cit., 262, 1913, p. 3.

Among the New Zealand specimens in two instances a form with narrow gnathopods and with the teeth at the end of the palm projecting almost at right angles to the palm itself, as figured by Chevreux for *S. dollfusi*, was taken along with the ordinary form described by Dana; both these forms occur also in Port Jackson, New South Wales. As I can find no difference among the females, I feel pretty certain that this should be considered another form of the male rather than a separate species so that *S. dollfusi* Chevreux will also become a synonym of *S. valida* Dana. This seems to be confirmed by the fact that Kunkel in his account of the amphipoda of the Bermudas records specimens as *S. valida*, while the figure that he gives shows a gnathopod very much like that figured for *S. dollfusi* by Chevreux.[20] The species described by Chevreux as *S. crenulata* from the Gambier Archipelago seems to come very close indeed to *S. valida*, but in it the ramus of the third uropods is curved, while in all the specimens of *S. valida* that I have been able to examine it is straight and pointed at the end in the usual way. Barnard considers *S. crenulata* a synonym of *S. gallensis* Walker and has recorded it from South Africa, referring his specimens to this species because the female specimens examined by him had this peculiar character of the third uropod.

It is evident that the different species assigned to this genus are all very similar in most characters except the gnathopoda, and it is quite possible that the number of species requires to be still further reduced. The characters of *S. marina* from Europe as given by Sars seem to correspond pretty closely with some of the female specimens of *S. valida.* I am in some doubt with regard to the shape and development of the second gnathopod in the females of this latter species, for apparently they show almost complete transitions from the form found in small specimens bearing eggs to the greatly enlarged gnathopods found in the fully adult males. At first I had considered these intermediate forms to be immature males, but some of these are certainly found bearing eggs. Kunkel has recorded both *S. marina* and *S. valida* from the Bermudas, and the figure that he gives of the form referred to *S. marina* corresponds very closely indeed with some of the females found in New Zealand that I have referred to as *S. valida.* Further investigation of this point and of the degeneration of the mouth parts in fully matured males is very desirable.

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[20] Since this was written, I have compared the New Zealand specimens with specimens of *S. dollfusi* taken at Banyuls-sur-mer on the south coast of France, and find complete correspondence both in the male and in the female. One of the two female specimens from Banyuls shows the concave palm as figured by Chevreux; another female from Banyuls, however, has the palm regularly convex as in *S. valida* Dana, and appears indistinguishable from New Zealand specimens.

The chief synonyms of *S. valida* may be given as follows:—

STENOTHOE VALIDA *Dana.*

Stenothoe validus, Dana, 1853 and 1855, U.S. Expl. Exped. 13 ii, p. 924, pl. 63, fig. 1 a-o.

Stenothoe valida, Stebbing, K. Pr. Akademie Wiss., Berlin, Das Tierrich, Lief. 21, 1906, p. 194.

Stenothoe valida, Walker, Proc. U.S. Nat. Museum, xxxviii, 1910, p. 621.

Stenothoe valida, Kunkel, Connecticut Acad. Arts & Sci., Trans., xvi, 1910, p. 16.

Stenothoe valida, Chevreux, Bull. Inst. Oceanogr. 262, 1913, p. 3.

Stenothoe valida (part) Della Valle, Fauna & Flora des Golfes von Neapel, xx, 1893, p. 566, pl. lviii, figs. 74-78.

Stenothoe adhaerens, Chilton, Trans. N.Z. Inst., xxiv, 1891 (1892), p. 259 (? not Stebbing, Chall. Rep. Zool. xxix, 1888, p. 199).

Stenothoe assimilis, Chevreux, Bull. Inst. Oceanogr. 113, 1908, p. 4.

Stenothoe assimilis, Walker, Proc. U.S. Nat. Museum, xxxviii, 1910, p. 621.

? *Stenothoe dollfusi* Chevreux, Bull. Soc. Zool. Fr., xvi, 1891, p. 260; Stebbing, K. Pr. Akademie Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 196.

Montagua miersii and *Montagua longicornis,* Haswell, P.L.S. N.S.W., iv, 1880, p. 323, pl. 24, figs. 4 and 5.

Montaguana miersii, Chilton, Trans. N.Z. Inst., xv, 1883, p. 79.

Probolium miersii, Chilton, P.L.S. N.S.W., ix, 1885, p. 1043.

Stenothoe miersii, Stebbing, K. Pr. Akademie Wiss., Berlin, Das Tierreich, Lief. 21, 1906, p. 200.

Size.—About 5 mm.

Colour.—Whitish or pale yellowish.

Distribution.—South America, Australia, New Zealand, etc.

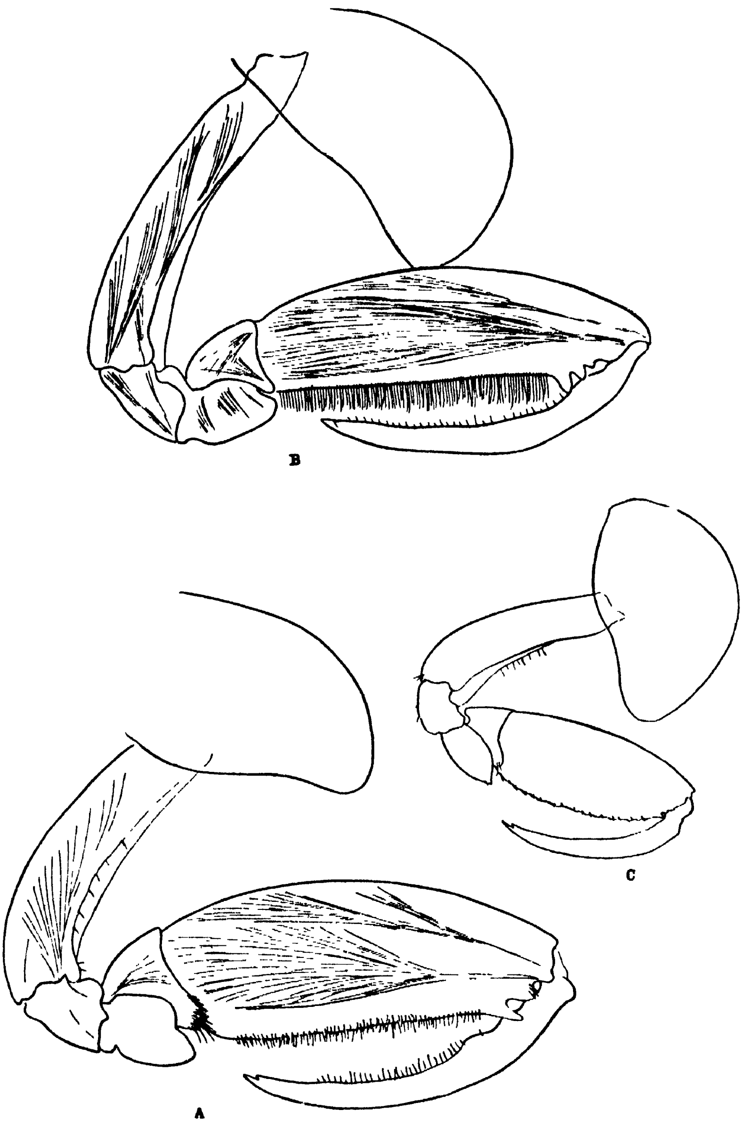

Figure 5. *Stenothoe valida* Dana.

A. Second gnathopod of male (*S. valida* form).
B. Second gnathopod of male (*S. dollfusi* form).
C. Second gnathopod of female or immature male.

MINERALOGICAL NOTES: No. I.

By

T. Hodge Smith, Mineralogist and Petrologist.

(Plates xii.-xiii.)

The Occurrence of Garnet at Bowling Alley Point, near Nundle, New South Wales.

(Plate xii.)

The discovery of colourless garnets occuring in the Great Serpentine Belt at Bowling Alley Point was made by Mr. D. A. Porter. In a personal letter he supplies the following information:—"I first noticed them in 1884, at about 200 yards north of Anderson's Rock, and the first specimen I found was loose on the surface, and the garnet crystals were seated on and about quite a fine prism of green vesuvianite: I have never seen as fine a specimen since. Professor Liversidge got it eventually."

The Museum collection contains about three hundred specimens from here. They were collected by Mr. D. A. Porter, Dr. C. Anderson (the Director), and the writer.

No detailed description of the garnets has been published, although as early as 1888 Professor Liversidge[1] records them as grossularite. Later Professor Benson[2] applied to them the name, topazalite. The same writer has described the Great Serpentine Belt of New South Wales very exhaustively in several papers. He also treats the subject of the included garnet-rocks, more particularly at Bingara, New South Wales.

The garnet consists of small, colourless, glassy crystals, and also of white opaque masses. The crystals always display the same habit, being dodecahedra. In size they vary from 1 mm. to 5 mm. in diameter. At times they exhibit a faint honey-yellow colour, but for the most part, are colourless and transparent. Material for chemical analysis was picked carefully and was very pure. The result of that

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[1] Liversidge—Minerals of New South Wales, 1888, p. 204.

[2] Benson—Proc. Linn. Soc. N.S.W., xxxviii, 4, pp. 569-596 and 662 742.

analysis is given below, together with an analysis of the grossularite from Roding River, New Zealand, for comparison.

	I.	II.	III.
SiO_2 ...	39·96	36·33	2·9
Al_2O_3 ...	23·21	25·64	1·0.
Fe_2O_3 ...	0·68	abs.	
FeO ...	0·95	0·50	2·8
MgO ...	0·53	0·20	
CaO ...	35·04	36·19	
Na_2O ...	n.d.	0·14	......
K_2O ...	n.d.		... ..
H_2O ...	......	0·62	......
TiO_2 ...	......	0·05	...
Cr_2O_3 ..	.. ...	0·05	......
MnO ...	trace	0·15	......
	100 37	99·87	... ..

I. Grossularite, Bowling Alley Point, New South Wales, Anal. T.H.S.
II. Grossularite, Roding River, New Zealand, Anal. Maclaurin.
III. Molecular ratios derived from I.

From the above analysis, it will be seen that the formula is approximately $3CaO\ Al_2O_3\ 3SiO_2$, which is that of grossularite. The specific gravity is 3.58. These crystals occur in numerous small fissures intersecting dykes which have intruded the serpentine, and are not found outside of these dykes except in curious masses of rock which resemble the dyke rock. The associated minerals are prehnite, chalcedony, and vesuvianite.

From the map of the area under discussion (Plate xii), it will be noticed at once that the dykes are confined to the western side of the serpentine, except where the serpentine belt becomes comparatively narrow. Their strike is roughly parallel to that of the serpentine itself. Their width varies from one foot to about six feet, while they can be traced along the direction of their strike only for a few chains at most. The variation in texture of the different dykes is most marked, and it may exist in any one dyke in the direction of the strike. There is also a variation in the mineral constitution of the rocks. In places it is a normal gabbro changing by almost imperceptible stages through garnet-gabbro and prehnite-garnet-pyroxene rock to garnet-pyroxene rock, the rodingite of H. P. Marshall.

The occurrence of basic and even acid dykes intruding serpentine has been recorded by several writers. H. P. Marshall[3], in describing the dykes intruding the serpentine in the Mt. Dun region, New Zealand, expresses the opinion that the dykes (grossularite rock) are not derived by decomposition or by any metamorphic process. He considers that they are primary ultra-basic rocks, and gives the name rodingite to them.

R. P. D. Graham[4], in describing the injection of the granite rocks into the serpentine of the Black Lake-Thetford Area, Quebec, Canada, suggests that "the Granite injections were accompanied by hydrothermal waters capable of producing somewhat intense pneumatolitic action." He bases this statement on the presence of dykes of vesuvianite, grossularite and diopside cutting the serpentine. He further considers that "the granitic magma, as it made its way along fissures in the peridotite and associated rocks, was able to exert a powerful solvent action on the very basic minerals it encountered, owing mainly, no doubt, to its own extreme acid composition and to its content of aqueous and other volatile constituents; . . ."

W. N. Benson[5], in describing the masses of pale green or white grossularite rocks in the serpentine at Bingara, New South Wales, expresses the opinion "that the addition of lime was obtained during the process of serpentinisation" and that the gabbro was intruded before the hydration of the serpentine.

In regard to the view that these grossularite rocks are primary, the whole of the field evidence obtained from the area under review seems to be opposed to it. They are certainly the result of the alteration of the original gabbro. The argument of the extreme acid composition of the original dyke rock is not applicable in this case, as the original dyke rock was basic in composition.

The following is a list of the secondary minerals found both in the serpentine and the dykes:—

Dykes:	*Serpentine*:
Chalcedony, etc.	Chalcedony, etc.
Calcite (very little).	Magnesite.
Grossularite.	Asbestos.
Prehnite.	Serpentine.
Vesuvianite.	

This at once suggests that these secondary minerals originate from the action of the same agency on the two different rocks, i.e., the metamorphism of the gabbro and the peridotite to grossularite rock and serpentine respectively is the result of the one agency. It is important to note in this connection that the dyke rock has been subjected to much strain, and, like the serpentine, is much slickensided. This implies the injection of the gabbro rock before the conversion of the original ultra-basic rock into serpentine.

[3] Bell, Clarke and Marshall—Bull. Geol. Surv. N.Z., 12, 1911.
[4] Graham—Economic Geology, 1917, pp. 154-202.
[5] Benson—Am. Jour. Sci. (4), xlvi, 276, 1918, pp. 694-731.

In regard to the curious masses included in the serpentine, it is found that they are confined entirely to near the western boundary. They are either rounded or more or less lenticular in shape, and vary in size from about one foot to as much as ten feet measured along the longer diameter of the lens. At first sight they suggest fragments of country rock (limestone) caught up in the peridotite intrusion and subsequently altered. There is, however, no field evidence in support of this view; on the other hand, the larger masses show a distinct lithological similarity to the dyke rock. Furthermore, no contact between limestone and serpentine was found. Thus one is forced to the conclusion that they both have the same origin. It might be suggested that the peridotite intrusion accompanying large orogenic earth movement has tapped the magma reservoir from which it is derived, from its base. This offers an explanation of these curious masses. They would then represent portions of the overlying gabbro magma caught up by the very viscid ultra-basic magma. The distribution and the shape of these masses are in accord with this view. These portions of the gabbro magma need not necessarily have been solid at the time of their enclosure, indeed it seems improbable that they were. These, then, have been subsequently altered by the same agency as the dykes and the peridotites.

Many have been the writers on the subject of the agency by which the serpentine has been produced. W. N. Benson[5] has summarised this work in his "Origin of Serpentine." The evidence in the present case supports the idea that the garnet was produced by magmatic solutions either accompanying the injection of the gabbro or closely following it. That these solutions were highly charged with silica is shown by the presence of chalcedony in the fissures of the dyke rock as well as fairly large masses of siliceous sinter and opal in close proximity to the dykes. There is a complete absence of crystallised calcite in the fissures of the dykes, but it is present as a decomposition product of the felspar of the gabbro, indicating that carbonic acid was present in the magmatic waters, but not nearly to the same extent as silica.

The processes which led to the formation of the grossularite may be summarised thus:—

(1) Intrusion of the ultra-basic rock. In the final stages portions of the overlying basic magma were caught up and included in it.

(2) The intrusion of the gabbro either accompanied, or closely followed, by

(3) The intrusion of magmatic waters containing silica and a little carbonic acid, effecting the alteration both of the serpentine and the gabbro, and depositing the grossularite and its associated minerals in the fissures of the altered gabbro rock.

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[5] Benson—loc. cit.

ON THE CHEMICAL COMPOSITION OF MOLYBDITE.

About the middle of the nineteenth century D. D. Owen[7] analysed a specimen of molybdic ochre and found that it contained 35 per cent. of ferric iron and 15 per cent of water. According to E. S. Dana[8], Genth proved that the specimen was a mixture of limonite and molybdic ochre. However, Owen especially mentions the purity of his sample, and the writer suggests that only part of the iron was present in the form of limonite.

In 1891, W. T. Schaller[9] analysed samples of molybdite from various American localities, and found that their composition agreed very nearly to the formula $Fe_2O_3\ 3MoO_3\ 7\frac{1}{2}H_2O$. He also pointed out that the optical properties of the mineral were quite distinct from those of the artificially produced oxides of molybdenum.

In 1918, L. C. Ball[10] reported as follows:—"While testing my specimens it was found that certain molybdic ochres are rich in iron and moisture, the inference being that beside the oxide of molybdenum there is a hydrated molybdate of iron, in which I am supported by Mr. F. E. Connal, of the Government Analyst's staff."

Through the kindness of Mr. Inspector G. Smith a fine specimen of molybdite from Wilson's Downfall, New South Wales, was obtained. It occurred as a fibrous radiating aggregate lining cavities in quartz. A little earthy, yellow limonite was associated with the mineral. A number of very small crystals of quartz, some being doubly terminated, were found to be wholly surrounded by the fibrous mass of molybdite. A little over a quarter of a gram was obtained for analysis. This material was carefully picked as free from impurities as possible, and examined under the microscope. The method of analysis used by W. T. Schaller was followed, and the results obtained are given in the table below:—

	1	2	3	4
H_2O ..	18·40	18·77	7·42	18 57
Fe_2O_3 ...	22·81	23 27	1·00	22·01
MoO_3 .	56·81	57·96	2·86	59·42
Insoluble	1 67	......		
	99 69	100·00	......	100·00

No. 1 Column is the actual analysis made.

No. 2 Column is the analysis with the insoluble deducted and reduced to 100 per cent.

No. 3 Column is the ratio.

No. 4 Column is the theoretical analysis for $Fe_2O_3\ 3MoO_3\ 7\frac{1}{2}H_2O$.

[7] Owen—Proc. Acad. Nat. Sci. Philad. vi, 1852, p. 108.
[8] Dana—System of Mineralogy, 6th ed., 1892, p. 202.
[9] Schaller—Am. Jour. Sci. xii, 1891, p. 138.
[10] Ball—Ann. Rept. Dept. Mines, Queensland 1918, p. 202.

It is seen that the ratios approximate the theoretical formula. The iron is somewhat high, probably being due to a small admixture of limonite which is associated with the mineral.

Under the microscope the mineral is seen to be crystallised in very small acicular crystals. By transmitted light the colour is pale yellow to almost colourless. There is a very strong absorption parallel to the long axis of the crystals. This absorption is so marked that in this position the appearance of the mineral in thick sections is almost black. Between crossed nicols all crystals show straight extinction. The double refraction is strong.

Artificial molybdenum trioxide and molybdic acid were examined under the microscope. It was found that in neither case did the optical properties agree with those stated above. Thus an examination under the microscope seems sufficient to distinguish the oxide from the hydrous ferric molybdate.

As the mineral generally occurs as an encrusting mineral, it is often impossible to obtain enough material for analysis. However, specimens from the following New South Wales localities were examined under the microscope:—Wilson's Downfall, Hugh Weir's Claim (about thirty miles south-east of Tenterfield, near Moonbi), Bald Knob (about fourteen miles north-east of Glen Innes), Elliot's Block (near Jingera), Glen Eden, and Mt. Metallic Mine, Jingera.

It is interesting to note that those specimens that appear earthy, even under the pocket lens, are found to be well crystallised under the microscope. In every case the habit and optical properties were identical with those cited above. This fact precludes the idea of there being a mixture of the oxide with the hydrous ferric molybdate.

From the convergence of evidence from America, Queensland and now from New South Wales, it is proved that the hydrous ferric molybdate is a definite mineralogical compound. On the other hand, the writer can find no proof that the trioxide of molybdenum does occur in nature. There is a very rare mineral, ilsemannite, with the composition of MoO_2 $4MoO_3$ which, so far, has only been found at Bleiberg, Carthinia and Cripple Creek, U.S.A. It is entirely different from molybdite both in colour and solubility. The colour is a deep prussian blue, and the mineral is soluble in water.

Since the foregoing was written it has come under the notice of the writer that W. T. Schaller[11] has shown that ilsemannite is a hydrous sulphate of molybdenum.

In conclusion, the suggestion is made that the name molybdite be applied to the hydrous ferric molybdate, leaving a new name for the trioxide when it is proved to occur as a natural compound.

[11] Schaller—Jour. Wash. Acad. Sci., vii, 1917, pp. 417-420.

WOLLASTONITE.

South Blocks Mine, Broken Hill, New South Wales.

Two specimens were obtained by Mr. Geological-Surveyor A. Coombe, now of the Geological Survey of Uganda, from the No. 4 level (530 feet) of the South Blocks Mine, Broken Hill. One of these he very kindly presented to the Trustees. Wollastonite has been recorded from the East Consols Mine, Broken Hill, by Mr. Inspector George Smith[12], of the Mines Department, Sydney. However, the specimen received from Mr. Coombe was of such peculiar appearance and habit that it was thought worthy of description.

It occurs as tabular crystals scattered irregularly throughout a mass of cubical galena. The colour is pale brownish-red, and the crystals in one or two cases are slightly curved. They measure up to 25 mm. x 15 mm. x 2 mm. The presence of three well-developed cleavages parallel to the *b* axis, i.e., the longer direction, gives the mineral a fibrous appearance. The cleavage parallel to $(\bar{1}01)$, which is usually not so perfect, is remarkably well developed. The optical axial angle is large, and the optical character is negative. $x \wedge c =$ 32° 30′ approximately. There are present many inclusions of diopside, galena and manganese and iron ores.

Owing to the presence of these numerous inclusions it was impossible to obtain material sufficiently pure for analysis.

Six crystals were measured by Dr. C. Anderson, and from his measurements the following forms have been identified:—c(100), u(001), v(101), t$(\bar{1}01)$. One of the crystals had small terminal faces, but, as they gave either no signal at all or else a very poor one, it was impossible to recognise the forms to which they belong.

The following table gives the mean measured ϕ and ρ angles, together with the calculated angles.

Form	Measured		Calculated		Difference	
	ϕ	ρ	ϕ	ρ	ϕ	ρ
	° ′	° ′	° ′	° ′	′	′
u (001)	90 00	5 24	90 00	5 30	0	6
c (100)	90 1	89 58	90 00	90 00	1	2
v (101)	90 00	45 30	90 00	45 33	0	3
ι $(\bar{1}01)$	89 58	39 43	90 00	39 35	2	8

12 Smith—Mem. Geol. Surv. N.S.W., Geology No. 8, 1922, App. iv, p. 416.

TOPAZ.

Blatherarm Creek, New South Wales.

(Plate xiii, Figures 1-4.)

The Trustees obtained seven crystals of topaz from Blatherarm Creek, four and a half miles north of Torrington, by exchange with Mr. Inspector George Smith. These crystals were obtained from alluvial tin workings, but they are also associated with the wolfram and tin lodes of this district. All were measured on a two-circle goniometer and the results embodied in these notes.

The Director (Dr. C. Anderson) has described topaz from Emmaville, Oban[13], Carpet Snake Creek (near Torrington)[14], and Cow Flat (near Torrington)[15].

The crystals vary in size from 17 mm. x 18 mm. x 20 mm. down to 5 mm. x 9 mm. x 8 mm., measured approximately along the *a*, *b* and *c* axes. In no case were they doubly-terminated. They are clear and colourless, except three which have a faint bluish tinge. In the case of crystal vi, some mineral with a prismatic habit and an hexagonal cross section, has penetrated the crystal approximately parallel to the *b* axis. The mineral, however, has been removed, leaving only the cavity which it previously filled.

The following table gives the combinations observed in the seven crystals:—

Forms	1	2	3	4	5	6	7
c (001)	*c*	*c*	*c*	*c*	*c*	*c*	*c*
m (110)	*m*	*m*	*m*	*m*	*m*	*m*	*m*
l (120)	*l*	*l*	*l*	*l*	*l*	*l*	*l*
g (130)	*g*	*g*	...	..	...	...	...
M (230)	*M*	*M*	.	...			.
n (140)	..	*n*	.		..	.	.
d (201)	*d*	*d*	*d*	*d*	...	..	.
h (203)	*h*	...				.	
f (021)	*f*	*f*	*f*	*f*	*f*	*f*	*f*
y (041)	*y*	*y*	*y*	*y*	...		...
o (221)	*o*	*o*	*o*	*o*	*o*	...	...
u (111)	*u*	*u*	*u*	*u*	*u*		...
ι (223)	*ι*	*ι*	...	...	..	.	.
r (241)	*r*	.	..	..	..	.	...

[13] Anderson—Rec. Austr. Mus., v, 5, 1904; *Ibid.*, vi, 2, 1905.
[14] Anderson—*Ibid.*, vii, 4, 1909.
[15] Anderson—*Ibid.*, vii, 1, 1908, *Ibid.*, viii, 2, 1910.

In all fourteen forms have been recognised, of which one—r(121) —has not been recorded previously for any locality in New South Wales. The forms are c(001), m(110), l(120), g(130), M(230), n(140), d(201), h(103), f(021), y(041), o(221), u(111), i(223), r(241). The forms π (250), x(243), o(560), and b(010) have been recorded by Dr. Anderson for other New South Wales localities, but apparently are not present in the crystals under consideration.

Crystal i (Plate xiii, Figures 1-2) :—Measures 9 mm. x 16 mm. x 16 mm., when measured along the *a*. *b*. and *c* axes respectively.

The base is somewhat pitted and dull, giving a rather blurred signal. Of the brachydomes f(021) and y(041), the former has two faces developed while the latter is only represented by one face, which is much brighter though smaller. Of the orthodomes present, the form h(203) is larger, and both are rather dull. The pyramids are developed in a somewhat curious manner. The form o(221) is represented by two long, narrow faces only, u(111) has its full complement of four faces, two of which are long and narrow and two fairly large, i(223) is represented by three fairly large faces, and r(241) has three small faces. The brightness of the pyramids increases as their value of ρ increases. The prisms l(120) and m(110) are both striated parallel to the prism edges. The other prisms present are narrow, but have their full complement of four faces, except g(130), of which only two faces are developed. They are all bright.

Crystal ii (Plate xiii, Figures 3-4) :—Measures 16 mm. x 26 mm. x 19 mm. This crystal is characterised by the development of a very large face belonging to the form f(021). It shows evidence of etching, the etched figures being more or less pear-shaped with the flat part towards the base. The other brachydome y(241) has two bright faces, which are striated parallel to the *a* axis. The only orthodome present has large, bright faces. The pyramids are all dull, not giving very good signals. The base is pitted and dull. The prisms are all bright, though striated parallel to the prism edges, except the form m(110), which has striations at right angles to these, but not so well developed.

Crystals iii and iv:—They are similar in habit and size, measuring about 5 mm. x 8 mm. x 15 mm. The brachydome f(021) is very large and somewhat dull. In crystal iii it is striated parallel with the edge of o(221). The other brachydome y(041) is small and bright. In crystal iv, it is striated parallel to the *a* axis. The pyramids are represented by u(111) and o(221), both of which are equally developed The base is much pitted, and appears as an area of bright spots. Of the two prisms present m(110) is much the larger.

Crystal v:—Measures 10 mm. x 20 mm. x 14 mm. It is similar to crystals iii and iv, except that the domes y(041) and d(201) are absent.

Crystals vi and vii:—They are simple in habit, and about equal in size, measuring approximately 14 mm. x 16 mm. x 20 mm. The base is very narrow and much pitted. The only other terminal face is the brachydome f(021), which is large and dull. In the case of Crystal vii, it has the etched figures as described in crystal ii. The prisms m(110) and l(120) are both striated, and the former is the larger.

Below is a table of the forms observed, the average of ϕ and ρ angles, and the theoretical ϕ and ρ angles calculated from indices and elements:—

Form	Measured		Calculated		Error	
	ϕ	ρ	ϕ	ρ	ϕ	ρ
	° ′	° ′	° ′	° ′	′	′
m (110)	62 05	90 00	62 08	90 00	03	00
l (120)	43 23	90 00	43 25	90 00	02	00
g (130)	32 16	90 00	32 14	90 00	02	00
M (230)	51 34	90 00	51 35	90 00	01	00
n (140)	25 16	90 00	25 19	90 00	03	00
d (201)	89 59	61 06	90 00	61 00	06	01
h (203)	90 00	30 17	90 00	31 02	00	45
f (021)	00 01	43 41	00 00	43 39	01	02
y (041)	00 00	62 23	00 00	62 20	00	03
c (001)	... ...	00 00	... ...	00 00	...	00
o (221)	62 08	63 53	62 08	63 54	00	01
u (111)	62 09	45 37	62 08	45 35	01	02
i (223)	62 20	33 43	62 08	34 14	12	31
r (241)	43 28	69 11	43 25	69 09	03	02

Quartz.

Tingha, New South Wales.

(Plate xiii, figure 5.)

An interesting crystal of quartz was obtained from a locality thirteen miles west of Tingha, but unfortunately nothing is known of its mode of occurrence or associated minerals.

It measures 18 mm. along the *c* axis, and is almost clear and transparent, having a faint, smoky brown appearance. It is not doubly

terminated. The crystal was measured on a two-circle goniometer, and from the readings a stereographic projection was drawn. From this it was obvious that the crystal was composed of two Dauphiné twins of left-handed quartz, *i.e.*—four individuals in all. These twins were intergrown in such a manner that their $\dot{c}$ axes were parallel but the horizontal axes of one twin were rotated through an angle of 2° 55′ with reference to those of the other. The junction line of the two twins is in the main irregular and visible to the eye. It was quite impossible to distinguish the junction lines of the individual parts of the twins and the crystal was etched with hydrofluoric acid which served also to distinguish the positive form from the negative forms. In pl. xiii, fig. 5, the relative position of the twins is shewn.

In the twin represented by the shaded portion, the following forms were identified: m$(10\bar{1}0)$, e$(60\bar{6}1)$, $e_{,}(0\bar{6}61)$, i$(50\bar{5}3)$, i′$(0\bar{5}53)$, r$(10\bar{1}1)$, Z$(01\bar{1}1)$, $x_{,}(61\bar{5}1)$, $\phi_{,}(71\bar{6}3)$, $s_{,}(2\bar{1}\bar{1}2)$. The same forms were developed in the other twin except for a complete absence of the form $\phi_{,}(71\bar{6}3)$. There seems to be no previous reference to this form although its positive form ϕ (6173) has been recorded. The signals for the faces of this form were only fair, and the faces themselves were small and striated.

The lettering and axial ratios are in accordance with those of Dana: the unit face being the first order pyramid r(1011), *i.e.*, Goldschmidt's "G_2" position.

The measured and calculated ϕ and ρ angles are as follows:—

Form	Measured		Calculated		Difference	
	ϕ	ρ	ϕ	ρ	ϕ	ρ
	° ′	° ′	° ′	° ′	′	′
m (1010)	0 0	90 0	0 0	90 0	0	0
r $(10\bar{1}1)$, z $(01\bar{1}1)$	0 6	51 46	0 0	51 47	6	1
e $(60\bar{6}1)$, e_1 $(0\bar{6}61)$	0 17	82 17	0 0	82 31	17	14
i (5053), i $(0\bar{5}53)$	0 3	64 44	0 0	64 43	3	1
s_1 $(2\bar{1}\bar{1}2)$	30 10	65 43	30 0	65 30	10	10
x_1 $(61\bar{5}1)$	8 55	81 57	8 57	81 57	2	0
ϕ_1 $(71\bar{6}3)$	30 10	65 43	30 0	65 33	0	10

In conclusion, I wish to thank Messrs. G. Smith and A. Coombe for the donation of specimens, together with much useful information, and Mr. D. A. Porter for his very able assistance in the field. To the Director, Dr. C. Anderson, my thanks are due for much valuable guidance and help in this work, and also for measurements of crystals.

FISHES FROM AUSTRALIA AND LORD HOWE ISLAND.

No. 2.

BY

ALLAN R. MCCULLOCH, Zoologist, Australian Museum.

(Plates xiv-xvi.)

The Fishes of Lord Howe Island are remarkable both for their large number of species and for their diversity. Many are tropical species and inhabitants of the coral-reef, which, though situated so far south, is very similar to the reefs of the Coral Sea. Others are pelagic forms, and some apparently come from the deep seas which encompass the island. Myctophids and Gempyllids are not infrequently cast up on the various beaches in considerable numbers, while such rarities as *Xenogramma*, *Argyropelecus*, *Tetragonurus*, *Zenopsis*, and *Cubiceps* have been made known from specimens found stranded on the sand. Some of these appear to be inhabitants of deep water, and the reason for their occurrence at the surface is not apparent. Perhaps some cold-water current is diverted from its course by unusual weather conditions, and brings the fishes from their usual environment to the surface where they become helpless under reduced pressure and higher temperatures. Whatever be the cause, the fact remains that the beaches of Lord Howe Island provide a host of interesting fishes so far unknown from any other source.

A number of these were secured for the Trustees of the Australian Museum by the late Mrs. T. Nicholls, and still others are coming to hand through the interest of Mr. R. Baxter, of which several are dealt with in the following paper.

Mr. E. H. Rainford, of Bowen, Queensland, continues to forward exceedingly rich collections from the neighbourhood of Port Denison. A remarkable new genus and species herein described is called *Rainfordia* as some small acknowledgment of his greatly valued help in making the fishes of that region known.

Family GONOSTOMIDÆ.

MAUROLICUS *Cocco.*

Maurolicus Cocco, Nuovi Ann. Sci. Nat. ii, 1838, p. 32 (*amethystino-punctatus*).

Triarcus Waite, Tr. N. Zeal. Inst. xlii, 1910, p. 387 (*australis*).

Synonymy.—When examining specimens of *Maurolicus australis* Hector, Waite, by some strange circumstance, counted only three instead of four gill-arches. He therefore removed the species from the family Gonostomidæ under a new generic name *Triarcus*. I am indebted to Mr. G. Archey, of the Canterbury Museum, for the loan of the two specimens studied by Waite, and for the privilege of re-examining them. I find four gill-arches as is normal in *Maurolicus*, though the outer arch is removed from one side of the smaller specimen, and all other characters similar to those of Cocco's genus.

MAUROLICUS PENNANTI AUSTRALIS *Hector*

(Plate xiv; fig. 1.)

Maurolicus australis Hector, Tr. N. Zeal. Inst. vii, 1875, p. 250, pl. xi. *Id.* Hutton, Index Faun. N. Zeal., 1904, p. 50.

Gonostoma australis Hutton, Tr. N. Zeal. Inst. viii, 1876, p. 215.

Maurolicus amethystinopunctatus Gunther, Ann. Mag. Nat. Hist. (4) xvii, 1876, p. 399, and Tr. N. Zeal. Inst. ix, 1877, p. 472.

Triarcus australis Waite, Tr. N. Zeal. Inst. xlii, 1910, p. 386, pl. xxxviii, fig. 1.

D.10-11; A.23; P.17-18; V.7; C.19. Depth, 4.6-4.7 in the length to the base of the tail; head, 3.2-3.7 in the same. Eye, 2.9-3.0 in the head, and longer than the snout.

Photophores.—Preorbital 1; Postorbital 1; preopercular 1; subopercular 1. Branchiostegals 6. Jugular 6. Lateral 9. Thoracic 12. Ventral 6. Anal 1, 15-17. Caudal 8-9. Body with large cycloid scales, most of which are missing.

Dorsal fin originating nearer the base of the tail than to the front margin of the eye. Ventrals inserted beneath the anterior dorsal ray. Anal originating behind the vertical of the last dorsal ray; the rays of its anterior third are longer and stronger than those of the remainder, but apparently the fin is not divided into two portions and its rays are evenly spaced. The dorsal and anal rays are so fragile and imperfect that the correct outline of these fins cannot be satisfactorily determined. Adipose dorsal long and opposite the hinder half of the anal. Pectorals reaching about half or more than half the distance between their bases and the ventrals.

Colour.—Dark above, silver on the sides, the junction of the two colours sharply defined.

Specimens examined.—These notes are based upon two examples from New Zealand, and one from Lord Howe Island. The two former are the specimens which were examined by Waite, who described and figured the larger example as *Triarcus australis*. He counted three instead of four gill-arches, and his statement of the number of

fin-rays does not agree with what I observe. The rays are difficult to see with a good Zeiss binocular microscope, however, so the discrepancy is easily accounted for. The accompanying figure is prepared from the smaller of the New Zealand specimens, which is in somewhat better condition than the other. The example from Lord Howe Island agrees in all details with the others.

Affinities.—The identity of *M. australis* and *M. amethystino-punctatus* (=*M. pennanti*) was suggested by Gunther in 1876. I have compared the New Zealand specimen with eight of *M. pennanti* from the Mediterranean and find no tangible differences between them. The dorsal fin is a little farther forward in *australis*, originating above the ventrals and terminating in advance of the vertical of the anterior anal ray. The general form also appears more slender than in *pennanti*, but the differences are so slight that they may well prove to be not even of subspecific value.

Localities.—Province of Canterbury, New Zealand. Two specimens, including the pleisotype of Waite's description and figure.

Blenkinthorpe Beach, Lord Howe Island; collected by R. Baxter, 1922. One specimen.

VINCIGUERRIA RAOULENSIS *Waite.*

Gonostoma raoulensis Waite, Trans. N.Z. Inst. xlii, 1910, p. 373, pl. xxxv, fig. 1.

This is a species of *Vinciguerria*, and is perhaps not distinct from *V. lucetia* Garman (Mem. Mus. Comp. Zool. xxiv, 1899, p. 242, pl. j, fig. 2). Gilbert (Mem. Mus. Comp. Zool. xxvi. 6, 1908, p. 237) suggests the identity of *V. lucetia* of the Pacific with the typical *V. attenuata* from the Atlantic.

Locality.—Raoul Island, Kermadec Islands.

Family MYCTOPHIDÆ.

LAMPANYCTUS TOWNSENDI, *Eig. & Eig.*

(Plate xiv; fig. 2.)

Myctophum townsendi Eigenmann and Eigenmann, W. American Scientist, 1889, p. 125.

Lampanyctus townsendi Gilbert, Mem. Mus. Comp. Zool. xxvi. 6, 1908, p. 230, pl. iv, and Mem. Carnegie Mus. vi. 2, 1913, p. 98.
D.14; A.15; P.14; V.8; C.19. L. lat. 37.

Depth (10.5 mm.) 5.04 in the length to the hypural joint (53). Head (17.25) 3.07 in the same. Eye (5.25) 3.2 in the head; snout (3) 1.7, and interorbital width (4.75) 1.1 in the eye. Caudal peduncle (5) 3.4, fifth dorsal ray (10.5) 1.6, and pectoral (15.5?) 1.1? in the head.

Snout formed by a convex crest. Supra-ocular margins sharp but without spines directed forward. Nostrils close together, the anterior small and round, the posterior a larger vertical slit. Preopercular margin oblique. A narrow band of villiform teeth in each jaw.

Origin of the dorsal fin much nearer the tip of the snout than the base of the tail, and a trifle behind the insertion of the ventrals; the length of its base is equal to the distance between its posterior ray and the hinder base of the adipose fin and is a trifle longer than that of the anal. Anal commencing beneath the posterior ray of the dorsal and terminating below the adipose dorsal. Ventral reaching the first anal ray, and the pectoral a trifle farther. Caudal forked. Body covered with cycloid scales; those of the lateral line not enlarged.

Photophores.—A minute preorbital before the eye and just below the level of the nostrils; none on the cheeks. Two on the preoperculum, the upper well above and the lower well below the level of the maxillary. The suprapectoral is just below the lateral line. Upper infrapectoral in front of and above the middle of the pectoral base, the lower somewhat in advance of it. Five thoracics, the first widely separated from the second, which, with the third and fourth, forms a straight row near the ventral surface; the fifth is placed just before the first ventral ray. Supraventral midway between the ventral fin and the lateral line. Five pairs of ventrals; the first close together immediately behind the inner ventral ray, the second and third more widely separate, the fourth close together again, and the fifth spaced, though less so than the third. Three supra-anals in an oblique row; the first slightly more forward than the others, the middle one is nearer the lower than the upper, which touches the lateral line. Six or seven antero-anals in an oblique row; the first slightly lower and the last somewhat higher than the others. Two postero-laterals, the upper touching the lateral line below the adipose dorsal and the lower obliquely in advance of it. Five postero-anals, separated by an interspace from the antero-anals and from the pre-caudals. Three pre-caudals in an oblique row above the lower caudal spines and one at the end of the lateral line.

Luminous scales.—The upper surface of the caudal peduncle, in advance of and including the caudal spines, the whole lower surface, and the base of the anal fin are covered by white glandular luminous organs. Some scales on the back between the nape and the dorsal fin, before the adipose dorsal, and on the ventral surface between the thorax and the vent, are luminous together with some above and below the pectorals and at the base of the dorsal fin.

Colour.—Black, the photophores appearing as silver discs surrounded with black rings. The articulations of the dorsal, anal, and caudal rays are marked with grey.

Described and figured from a specimen, 65 mm. long, which was found stranded with many others on a beach at Lord Howe Island. It is largely denuded of scales, but the distribution of the luminous scales has been determined with the aid of other specimens.

Identity.—The specimen here described and figured agrees well with Gilbert's description and figure of *L. townsendi* from Ua Huka Island in the Marquesas Group.

Localities.—Lord Howe Island, stranded on a beach; collected by R. Baxter, 1922. Sunday Island, Kermadec Group; collected by R. C. Bell, 1909-1910.

LAMPANYCTUS GUNTHERI (*Goode and Bean?*) *Waite.*

Lampanyctus guntheri Waite, Trans. N. Zeal. Inst. xlii, 1910, p .372. (Probably not of Goode & Bean.)

Identity.—Eight specimens which were collected at the Kermadec Islands in 1908 by Mr. W. R. Oliver, were identified as *L. guntheri* by Waite, but if his description of them be correct, they cannot be that species. He described the dorsal fin as arising midway between the front margin of the eye and the base of the caudal, which is much farther forward than in *L. guntheri;* also, he counted three opercular and only one anterolateral photophore, instead of two opercular and two anterolaterals.

Mr. G. Archey, Assistant Curator of the Canterbury Museum, informs me that he is unable to find Waite's specimens in the collection under his charge. There are seven other *Lampanyctus*, however, collected at the Kermadecs by Mr. R. C. Bell in 1909-10, a year or so later than those described by Waite. They have been lent to me for examination, and I find them similar in all details to the Lord Howe example described and figured above as *L. townsendi.* Believing Waite's description to be incorrect, I suggest that his specimens were the same species, as it is unlikely they were correctly identified as *L. guntheri.*

Family STERNOPTICHIDÆ.

ARGYROPELECUS Cocco.

Argyropelecus Cocco, Arch. R. Acad. Peloritano, 1829, p. 146 (*hemigymnus*).

Sternoptychides Ogilby, Proc. Linn. Soc. N.S.Wales (2) iii, 1888, p. 1313 (*amabilis*).

Though *Sternoptychides amabilis* differs considerably in general appearance from *Argyropelecus hemigymnus,* species intermediate in form have been described which prove *Sternoptychides* to be synonymous with *Argyropelecus.* Ogilby relied upon the dentition of *S. amabilis* to maintain his genus, but it is apparently similar to that of *A. caninus,* and is not essentially different from that of *A. hemigymnus.*

ARGYROPELECUS AMABILIS Ogilby.

(Plate xiv; fig. 3.)

Sternoptychides amabilis Ogilby, Proc. Linn. Soc. N.S.Wales (2) iii, 1888, p. 1313.

D.vii/9; A.?; P.10; V.?; C.17. About 34 muscle-bands between the shoulder and the base of the caudal fin.

Depth (32 mm.) 1.3 in the length to the hypural joint (42). Length of head (13) 3.2 in the same. Eye (5.8) 2.2 in the head; snout (3.5) 1.7 in the eye.

Interorbital space very narrow, with a crest on each side which commences above the nostril and converges towards the middle line till above the hinder portion of the eye, whence it again diverges to the nape; it terminates in a small occipital spine, and its posterior margin is feebly serrate. Another spine is present near the back, above the suspension of the shoulder-girdle. Nostrils large, close together before the middle of the eye. Eye apparently directed obliquely upward within the orbit. Mouth very oblique, the greater part of the margin of the upper jaw formed by the maxillary; this last is very thin and broad, and rather truncate posteriorly. Premaxillary teeth apparently in a single row, those near the symphysis larger than the others. A single row of curved teeth on the maxillary, of which the anterior ones are directed backward and the posterior forward. Mandibular teeth in two rows anteriorly and in one on the sides; several of the lateral teeth are enlarged and one is considerably longer than the others. Palate apparently toothless. Preopercular angle produced as a small spine. Gillrakers slender.

Photophores.—A large photophore is present on the preorbital immediately below the nostrils, and another behind the eye; one behind the end of the maxilla, and one behind the angle of the preoperculum; six form a row on the gill-membranes between the branchiostegal rays. Six form a curved row on each side of the isthmus, the hinder ones running upwards towards the base of the pectoral. Twelve on each side of the abdomen between the thorax and the ventral fin, and eight above them on the sides of which the two anterior are on a much higher level than the rest. Four pre-anal, six supra-anal, and four precaudal photophores.

The dorsal structure formed by the neural spines is supported by seven rays with serrulate borders, and the margin of the membrane is also finely serrate; the two posterior rays are close together. The origin of the dorsal fin is midway between the tip of the snout and the base of the caudal fin, and the length of its base is a little greater than the diameter of the eye; the rays are much broken, but are clearly nine in number. Adipose dorsal apparently consisting of a long low membrane. Anal fin very imperfect but apparently divided into two sections. Seven rays remain to represent the anterior half, of which the last is below the hinder margin of the second supra-anal photophore. Pectorals elongate, almost reaching the vertical of the ventrals. Ventrals scarcely discernible. Caudal forked.

The margin of the abdomen is finely serrated, the serræ being largest on each side of the vent. A series of minute spinules is also present on each side of the lower margin of the caudal peduncle.

Colour.—The greater part of the sides of the head and body is silver; the upper portion of the head and an area along the back, dark brown.

Described and figured from a specimen 42 mm. long without the tail. This is the best of the three typical examples upon which Ogilby based his genus and species *Sternoptychides amabilis.* Its caudal peduncle is damaged, so the precaudal photophores and spines have been copied from one of the others. All three are in such a bad state of preservation that they cannot be handled, and their examination is a matter of much difficulty. I am indebted to the Trustees of the Macleay Museum for the privilege of describing and figuring these specimens, which are the only known representatives of the species.

Locality.—Lord Howe Island.

Family RAINFORDIIDÆ *fam. nov.*

Genus RAINFORDIA *gen. nov.*

Body subcylindrical anteriorly, compressed posteriorly; head much depressed. Scales small, ctenoid; they cover the preorbital, maxilla and mandible and extend forward to the nostrils on the upper portion of the head, but leave the frontal bones exposed. Scales largely cover the soft dorsal, anal and caudal fins. Lateral line curved anteriorly, and reaching the base of the tail. Mouth large, mandible protruding; maxillary without a supplemental bone. Villiform teeth on both jaws, vomer and palatines. Preopercle with blunt teeth, operculum, suboperculum and interoperculum with strong projecting spines. Pseudobranchiæ present. Gill-membranes free from the isthmus. Upper portion of the operculum attached to the shoulder-girdle by membrane. Gill-rakers rather short, about ten on the lower limb of the first gill-arch. Branchiostegals seven. Two dorsal fins widely separated, the first with about four weak spines; second dorsal with a weak spine and about nine rays. Anal with two slender spines and eight rays.

Genotype.—*R. opercularis* sp. nov.

Affinities.—This aberrant genus appears to be nearest to *Grammistes*, its small scales extending over the fins, weak anal spines, and the attachment of the upper part of the operculum to the shoulder girdle by membrane being similar to those characters in that genus. Its subcylindrical form, spinate suboperculum, and depressed and partially naked head readily distinguish it from any other genus known to me. I therefore follow the advice of Professor D. S. Jordan, to whom I have submitted sketches and notes, and establish a new family for it to be ranged near the *Grammistiidæ.*

This genus is named after Mr. E. H. Rainford, whose untiring activities as a collector, have greatly enriched the Australian Museum with many rare finds from the coast of Queensland.

RAINFORDIA OPERCULARIS *sp. nov.*

(Plate xvi; fig. 3.)

D.iv, i/9; A.ii/8; P.17; V.i/5; C.17. L.Lat. 46; about 80 rows of scales between the origin of the lateral line and the hypural joint; thirteen scales between the base of the first dorsal spine and the lateral line and thirty-two more to the vent.

Depth (18 mm.) 5.7 in the length to the hypural joint (103); head (38) 2.7 in the same. Eye (8.5) 4.4 in the head, and 1.2 in the interorbital space (10.3), which is 3.6 in the head. Snout (10.3) a little longer than the eye. Second dorsal spine (14) 2.7, seventh dorsal ray (18) 2.1, and pectoral (21) 1.8 in the head. Depth of caudal peduncle (14) 1.5 in its length (21).

Head flat above with a large scaleless area exposing the frontal bones. It is almost completely covered with small cycloid scales, which extend forward above the eye to the level of the posterior nostril; they are also present beneath the eye, on the maxillary, mandible and all the opercles. Anterior nostril tubular, the posterior a simple opening above the antero-superior angle of the eye. Maxillary extending backward to below the posterior third of the eye, its lower angle produced into a broad, flat spine. Mandible projecting well beyond the upper jaw. Preoperculum broadly rounded with several blunt teeth along its edge. Operculum and suboperculum with nine sharp spines along their margins which are largest above. Interoperculum with two small spines at its angle. Each jaw with a broad band of villiform teeth, which is widest anteriorly. Vomer with a curved band of minute teeth of which the hinder ones are largest. A narrow band of very small teeth on each palatine, which is expanded anteriorly. Tongue toothless. Gill-openings wide, the membranes united below the middle of the eye across the isthmus. Ten free gill-rakers on the lower limb of the first gill-arch and about five tubercles anteriorly; the posterior is longest, and is equal to about one-third of the width of the eye.

Body but little narrower than deep behind the pectorals, but strongly compressed posteriorly. It is entirely covered with small scales which are mostly ctenoid, but are cycloid near the head. The lateral line consists of simple spaced tubules; it curves upward slightly above the pectoral and then gradually descends to the middle of the caudal peduncle.

First dorsal commencing well behind the pectorals; its spines are weak and the second is longest. Second dorsal short and separated from the first by a wide interspace; its spine is very slender and its lower half is largely hidden by scales. Anal similar to and almost

opposite the dorsal; its two small and slender spines are completely hidden by scales. Pectorals rounded. Ventral spine weak, inserted a little in advance of the pectoral. Caudal subtruncate with its angles rounded.

Colour.—General colour dark orange with six lilac, black-edged stripes along each side, as illustrated in the accompanying figure; the ground colour is darkest on the middle of the sides, but is lighter yellow on the dorsal and ventral surfaces. Dorsal spines yellowish, the membrane transparent. Second dorsal dark basally, with a broad oblique yellow infra-marginal band from the first to the tip of the seventh ray, and a narrow whitish edge; succeeding rays reddish brown. Anal similar to the dorsal. Pectorals and ventrals pinkish yellow. A black, blue-edged ocellus at the base of the caudal. Caudal brown; its outer angles with white borders.

Described and figured from a specimen 124 mm. long.

Locality.—Middle Island, Edgecumbe Bay, Queensland; collected by Mr. E. H. Rainford, 1922.

Family Labracoglossidæ.

Evistus huttonii *Gunther.*

Platystethus huttonii Gunther, Ann. Mag. Nat. Hist. (4) xvii, 1876, p. 395, and Challenger Rept., Zool. xxxi, 1889, p. 13, pl. ii, figs. h-i.

An example 190 mm. long, differs from Gunther's description and figure in having more numerous rays in the dorsal and anal fins, but is so similar in all other details that it is probably not distinct from *E. huttonii.*

D.xvi/43; A.iii/35; V.i/5; P.18; C.15. About 103 tube-bearing scales on the lateral line between its origin and the hypural joint; about 10 scales between the back and the lateral line below the middle of the first dorsal.

Locality.—Tamar River Heads, Tasmania; received from the Victoria Museum, Launceston, 1903. This rare and interesting fish has hitherto been known only from New Zealand waters.

Family Blenniidæ (Salariinæ).

Ecsenius *gen. nov.*

General form of *Salarias*, but differing in the dentition. A curved row of fine, compressed, and moveable teeth in each jaw anteriorly; on each side of the mandible is a lateral row of six or seven small cardiform teeth extending backward along the elevated ridge of the jaw. No teeth on the palate, and no canines. Body naked; lateral line developed anteriorly. Dorsal fin deeply notched between the spinous and rayed portions; the rays of all the fins are simple. Gill-openings very wide, the membranes united across but free from the isthmus.

Type.—*Ecsenius mandibularis* sp. nov.

The Australian genera of the Salariinæ may be distinguished as follows:—

A. A row of cirri crossing the neck to the opercular lobes. *Cirripectes.*

AA. No such row of cirri, but a single tentacle may be present on each side of the neck.

B. Each side of mandible either toothless or with a single canine.

C. Sides of mandible toothless. *Salarias.*

CC. A canine on each side of the mandible. subg. *Alticus.*

BB. Each side of mandible with a row of about six small teeth; no canines. *Ecsenius.*

ECSENIUS MANDIBULARIS *sp. nov.*

(Plate xv; figs. 1-2.)

D.xii/14; A.ii/17; P.13; V.2; C.13.

Depth (10.5 mm.) 4.7 in the length to the hypural joint (50); head (12) 4.1 in the same. Eye (4) 3.0 in the head. Fifth dorsal spine (10) 1.2, sixth dorsal ray (11) 1.09, twelfth anal ray (6.5) 1.8 in the head.

Anterior profile of the head almost vertical, the forehead projecting slightly beyond the jaws. A very low obtuse ridge on the occiput and nape. Maxillary reaching backward a trifle beyond the vertical of the hinder margin of the eye. Lips with entire margins. A simple tentacle at each posterior nostril; ocular and nuchal tentacles wanting. Head with a series of simple pores around the eyes, across the nape, around the preoperculum and on each side of the mandibles. Anterior mandibular row of teeth about half as long as that of the upper jaw and much less curved; the teeth are flattened, with rounded tips. The two rows of lateral mandibular teeth are subparallel, and the teeth are directed inwards towards each other (Fig. 2b).

Dorsal fin originating above the end of the operculum and very deeply notched between the spinous and soft portions; the anterior portion is a little shorter than the posterior. The fifth spine is longest, and a trifle shorter than the longest rays, and the twelfth is very short. Dorsal rays simple, the median ones longest. Anal rays simple, their tips with thickened dermal lobes anteriorly. Pectoral rounded, its rays simple; the fifth lowest longest and the four beneath it somewhat thickened. Ventral rays simple, inserted in advance of the origin of the dorsal. Caudal rays simple, some of them irregularly produced.

Colour-marking.—Light brown in formalin, with a bluish tinge on the sides. Two rows of brown spots which are round and spaced; the upper row near the back, the lower along the middle of the sides to the base of the tail. Fins almost without marking, but the thickened tips of the anal rays are distinctly lighter than the rest of the fin.

Described and figured from a male specimen, 64 mm. long.

Variation.—The female (Fig. 2a) differs from the male in the form of its fins and in having no occipital crest. The fin-rays are all shorter, and those of the anal lack the anterior dermal lobes. A series of twenty specimens shows that the fin-rays vary as follows:—D.xii/13-16; A.i-ii/16-18; P. 13; C.12-13; V.2, a minute third ray sometimes present.

Locality.—Twenty-three specimens, 46-64 mm. long, were collected by myself on the reef at Masthead Island, off Port Curtis, Queensland.

SALARIS *Cuvier.*

Key to Australian species..—

A. Dorsal fin not or scarcely notched between the spines and rays.
  B. No occipital crest.
    C. Nuchal tentacles large, fringed; body and fins variegated. ***fasciatus.***
    CC. No nuchal tentacles; body and fins nearly black. ***fuscus.***
  BB. An occipital crest. ***spaldingi.***
AA. Dorsal fin incised between the spines and rays.
  D. Mandibular canines large.
    E. 21 dorsal and 23 anal rays. ***belemnites.***
    EE. 17 dorsal and 19 anal rays. ***irroratus.***
  DD. Mandibular canine small or absent.
    F. Margin of upper lip crenulate.
      G. Ocular tentacles simple; about 18 dorsal and 19 anal rays; small mandibular canines present. ***crenulatus.***
      GG. Ocular tentacles fringed; 19-20 dorsal and 19-20 anal rays; no mandibular canines. ***meleagris.***
    FF. Margin of upper lip entire.
      H. Ocular tentacles simple; 19-20 dorsal rays. ***rivulatus.***
        (*S. mulleri* Klunzinger apparently enters this section.)
      HH. Ocular tentacles branched; 21-23 dorsal rays.
        (*S. kingii* Cuv. & Val. apparently enters this section.)
        I. Body with thin dark longitudinal lines; caudal plain. ***lineatus.***
        II. Body without longitudinal lines.
          J. No occipital crest; soft dorsal and caudal without dark borders. ***dussumieri.***
          JJ. An occipital crest; soft dorsal and caudal with dark borders. ***geminatus.***

SALARIAS FASCIATUS *Bloch.*

(Plate xv; fig. 3.)

Salarias fasciatus (Bloch) McCulloch & McNeill, *Rec. Austr. Mus.* xii, 2, 1918, p. 10—*references and synonymy.*

The accompanying figure represents a specimen, 69 mm. long, from a pool in the reef at Two Isles, off Cape Bedford, Queensland. It was collected by Messrs. C. Hedley and E. A. Briggs in July, 1916.

SALARIAS CRENULATUS *Weber.*

(Plate xvi; figs. 1-2.)

Salarias crenulatus Weber, Notes Leyden Mus. xxxi, 1909, p. 144, and Siboga Exped. lvii, Fische, 1913, p. 532, fig. 112.

D.xii/18; A.19; P.14; V.2; C.11.

Total length 79 mm. Depth (13 mm.) 4.8 in the length to the hypural joint (63); head (12.5) 5.04 in the same. Eye (4) 3.1 in the head. Ninth dorsal spine (11.25) 1.1 in the head; fifteenth dorsal ray (13) 0.04, and third anal ray (21) 0.6 longer than the head.

Orbit forming the anterior profile of the head and projecting beyond the jaws. A very low obtuse ridge on the occiput and nape. Maxillary reaching backward to below the hinder margin of the eye. Upper lip fringed with a row of short tentacles. A single row of fine moveable teeth in each jaw and a minute canine on each side of the mandible. Head with a series of simple pores around the eyes, across the nape, around the preoperculum and on each side of the mandible. A simple tentacle before and another behind the anterior nostril; Another longer one above the eye and a short one on each side of the neck.

Dorsal fin originating above the operculum and distinctly notched between the spinous and soft portions; the anterior portion is a little shorter than the posterior. The median spines are sub-equal in length but are shorter than the longest rays; the last is much shorter than the penultimate. Dorsal rays simple, increasing slightly in length to about the fifteenth; the last united by membrane to the base of the caudal. Anal rays simple, with the membrane deeply incised between each; the second to fifth are greatly produced and feather like, and the last is connected by membrane to the peduncle. Pectoral rounded, its rays simple, the sixth lowest longest. Ventrals of two simple rays, inserted beneath the origin of the dorsal. Caudal slightly rounded, its rays bifurcate.

Colour-marking.—Light yellowish-brown in formalin with eight dusky cross-bands, which may be very indistinct. The sides of the body beneath the spinous dorsal are mottled with numerous rounded brown spots, which give place to dark bluish spots below the soft dorsal. A dark bar from the eye crosses the preorbital to the chin, and a dark area on the cheeks forms a cross band on the throat. Upper portion of the opercular margin bluish-black. Dorsal fin with indefinite oblique dark lines. Pectoral with regular rows of brown spots on the rays. Median caudal rays dusky.

Described and figured from a male example, 79 mm. long.

Variation.—A female (Fig. 2) differs from the male in having the occipital ridge less pronounced, and none of the anal rays produced. In twelve other specimens, there are xii/18-19 dorsal, and 18-19 anal rays. Some are much lighter in colour than the others, and their markings are not often so well defined as in the specimen figured.

Identity.—The specimens here described and figured are evidently *S. crenulatus* Weber, though they have 18-19 instead of 16-17 dorsal rays, and exhibit some small colour differences. The white lines on the head, which are described by Weber, are not evident in any of my specimens, and the cross-bands of the body are situated upon the upper instead of the lower half. There are no spots on the caudal peduncle, and no rows of spots on the caudal fin. All these are small differences, however, and probably are due in part to the fact that my specimens are preserved in formalin instead of alcohol. I therefore believe them to be correctly identified as *S. crenulatus*.

Locality.—Coral-reef at Masthead Island, off Port Curtis, Queensland; collected by A. R. McCulloch, September, 1904.

SALARIAS RIVULATUS *Rüppell.*

Salarias rivulatus (Rüppell) McCulloch & McNeill, Rec. Austr. Mus. xii, 2, 1918, p. 15, pl. iii, figs. 3-4.

Salarias atratus Macleay, Proc. Linn. Soc. N.S. Wales vii, 1882, p. 361.

Synonymy.—*S atratus* is represented in the Macleay Museum by two specimens, 55 and 81 mm. long from Port Moresby. They are accompanied by their original labels and are clearly typical specimens, though they differ from Macleay's brief description in having xiii/20 spines and rays in the dorsal fins, and ii/22 in the anal instead of D.xii/20 and A.19 respectively. Nasal, ocular and nuchal tentacles are present in each, and also an occipital crest. They are almost bleached, but traces of colour-marking are present on the body and fins which, together with all other characters, are similar to those of *S. rivulatus* as described and figured by McCulloch & McNeill (*loc. cit.*).

Locality.—Port Moresby, Papua; collected by Andrew Goldie, 1881.

STUDIES IN AUSTRALIAN REPTILES.

No. 3.[1]

By

J. R. Kinghorn, Zoologist.

On the Genera and Species of Ophioseps and Aprasia.

For the purposes of this revision I have had the opportunity, through the generosity of the Trustees of the Western Australian Museum, of examining a series of eleven specimens belonging to the genus *Aprasia*, and also the type of *Ophioseps repens* Fry[2], in addition to fourteen specimens preserved in the Australian Museum. In the absence of specimens of the genotypes *Ophioseps nasutus* Bocage and *Aprasia pulchella* Gray, I have had to rely entirely on published descriptions and figures of these species, but all the supposed *Ophioseps* spp. which I have been able to examine, including Fry's type, really belong to the genus *Aprasia*[3].

Generic Characters.

The series examined ranges from young specimens to adults. In some premaxillary teeth are present, while in others they are absent; some have long snouts, while others have broad short ones; and the number of longitudinal rows of scales varies from 12 to 14.

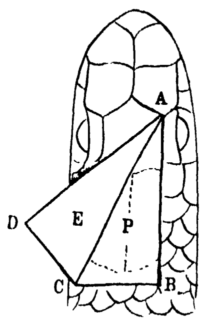


Fig. 1.

Make a clean cut through the skin, following the lateral border of the frontal shield from point A and extend to B. A second cut must be made from B to C, and a very fine scalpel inserted horizontally under point B and worked carefully back and forth until the loose flap of skin E can be turned back to D. The parietal bones P can then be easily examined.

[1] For No. 2, see "Records," xiii, 4, 1921, p. 143.

[2] Fry—Records W. Austr. Mus., i, 3, 1914, p. 174.

[3] Fry's mistake seems to have occurred through his misinterpreting the term *parietal plates;* he evidently referred to the head shields instead of the bones.

As in the case of the genera *Pygopus* and *Lialis* the chief diagnostic character is the condition of the parietal bone; in *Ophioseps* the parietal bone is single while in *Aprasia* it is divided into two, each half being slightly movable, relative to the other, if pressed with a needle. It would appear that more than one author has been misled by the terms "parietals paired" and "parietals single," and has interpreted them as relating to the head shields instead of to the bones. I thoroughly examined the skull of every specimen in the series before me, and Figure 1 will show an easy and clean method of cutting the skin of the head and turning it back so as to give a clear view of the parietals without in any way injuring the specimen or disarranging the head shields.

Jensen's figure[4] of *Ophioseps* (Figure 2) shows considerable differences in the shape of the skull bones as compared with *Aprasia* (Figure 3) but, making due allowance for the semi-diagrammatic quality of his drawing, I should be inclined to separate the genera by the paired or impaired condition of the parietals, rather than by the frontal entering the orbital space or being separated from it by the posterior extension of the prefrontals, which form a suture with the postfrontals.

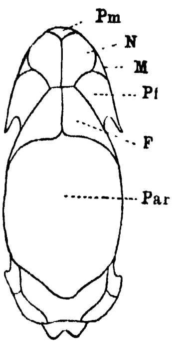


Fig. 2.
After Jensen.

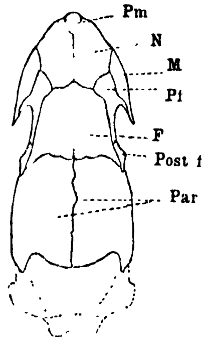


Fig. 3.
From specimen in Australian Museum.

F- frontal, M—maxillary, N=nasal, Par=parietal, Pf=prefrontal, Pm=Premaxillary, Post f—Postfrontal.

Although Jensen's figures show that premaxillary teeth are absent in *Ophioseps*, I do not feel justified in using it as a generic character under the present circumstances. *O. repens* Fry is without teeth, and *A. pulchella* Gray possesses them, but in all other generic characters the former is identical with the latter, and therefore Fry's *repens* must be placed, for the time being, in the genus *Aprasia*.

These comparisons lead me to the conclusion that there are two species of *Aprasia* in Australia, *viz.*, *Aprasia pulchella* Gray and *Aprasia repens* Fry.

[4] Jensen—Vidensk. Meddel., iii, 1900, p. 317, figs. A-C.

Key to Genera.

Parietal bone single, frontal reaching the orbit. (Fig. 2.)	*Ophioseps.*
Parietal bone paired, frontal separated from the orbit by the pre- and postfrontal. (Fig. 3.)	*Aprasia.*

OPHIOSEPS *Bocage.*[5]

Ophioseps Bocage, Journ. Acad. Lisboa, iv, 1873, p. 231.

Ophiopsiseps Boulenger, Brit. Mus. Cat. Liz., iii, 1887, p. 436.

Ophiopsiseps Jensen, Vidensk Meddel., iii, 1900, p. 317, pl. iii.

Ophioseps Werner, K. Pr. Akad. Wiss. Berl., Das Tierreich, Lief. 33, 1912, p. 26.

Degenerate form, closely related to *Aprasia*. Premaxilla not projecting far between the nostrils. Frontals paired. Parietal large, unpaired. Frontals reaching the orbits. Postfrontal and jugal are not present. Teeth only in the lower jaw, two on each side, very small. Ear opening concealed, rudiments of the hind limbs very small. Scales smooth, cycloid, no preanal pores.

OPHIOSEPS NASUTUS *Bocage.*[6]

Ophioseps nasutus Bocage, Journ. Acad. Lisboa, iv, 1873, p. 232.

Ophiopsiseps nasutus Jensen, Vidensk. Meddel., iii, 1900, p. 317.

Ophiopsiseps nasutus Boulenger, Brit. Mus. Cat. Liz., iii, 1887, p. 436.

Aprasia brevirostris Werner, Fauna. Südwest-Australiens, ii, 1909, p. 266, fig. 2.

Ophioseps nasutus Werner, K. Pr. Akad. Wiss. Berl., Das Tierreich, Lief. 33, 1912, p. 26.

Ophioseps nasutus Fry, Rec. W.A. Museum, i, 1912, p. 181.

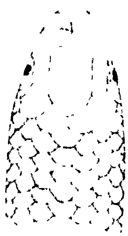


Fig. 4

Fig. 5.
After Jensen.

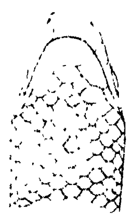


Fig. 6.

[5] Translated from Werner's description.
[6] Translated from Werner's description.

Snout projecting, rounded. Eye well developed, surrounded by a ring formed of small shields. Tail shorter and more slender than the rest of the body. Rostral shield higher than broad, with parallel sides, the part visible from above being triangular. Nasal shields in contact with one another behind the rostral, and fused with first supralabial. Nostril sometimes connected by means of a short horizontal fissure with the anterior side of the upper labial. Prefrontal shields paired, in contact in the middle line and on the side bordering the second upper labial. A large six or eight-sided frontal shield with rounded hinder edge. Parietal shields not larger than the adjoining scales. Postocular shield small or absent. A small supraocular shield. Mental large, the hinder side being truncate. First pair of lower labials large, separated in the centre by a second small shield. Fourteen rows of scales round the body. Sometimes two enlarged preanals.

Upper surface brown, the individual scales with parallel dark streaks in the centre. Those on the sides of the body are broader.

Locality.—Lion Mill, Donnybrook, West Australia (Type).

Genus APRASIA.

Aprasia Gray, Ann. Mag. Nat. Hist. ii, 1839, p. 331.
Aprasia Boulenger, Brit. Mus. Cat. Liz. i, 1885, p. 245.
Aprasia Werner, K. Pr. Akad. Wiss. Berl., Das Tierreich, Lief. 33, 1912, p. 25.

Parietal bones distinct, paired. Frontals paired, separated from the orbit by the posterior extension of the prefrontals, which form a suture with the postorbital.

Premaxillary teeth present (*pulchella*) or absent (*repens*), two teeth on each side of the lower jaw, all microscopic. Ear opening concealed. Slight rudiments of hind limbs externally, head with large symmetrical shields. No parietals. Scales smooth, cycloid, imbricate. Belly scales scarcely enlarged. No preanal pores.

Habitat.—West and South Australia.

Type of genus in British Museum (Natural History) (*A. pulchella* Gray).

A comparison of the characters of the twenty-five specimens examined showed that those of *A. repens* were consistently similar while those of *A. pulchella* alone varied sufficiently to be dealt with in detail.

Whatever modifications or slight variations may occur, as far as head shields are concerned, it is positive that all those specimens which I have placed as *A. repens* are without premaxillary teeth, and have a long narrow snout, whereas those placed under *A. pulchella* possess teeth and have a broader and shorter snout. Furthermore the postocular scale is absent in *A. repens* and present in *A. pulchella.*

Key to the species of *Aprasia*:

Postocular present,	4th upper labial separated from the supraocular by the postocular scale. Length of snout from eye, less than 3 times the diameter of eye. Premaxillary teeth present	*A. pulchella.*
Postocular absent,	4th upper labial in contact with supraocular. Length of snout from eye, equal to 3 or more times the diameter of the eye. Premaxillary teeth absent	*A. repens.*

Aprasia pulchella *Gray.*

Aprasia pulchella J. E. Gray, Ann. Mag. Nat. Hist., ii, 1839, p. 331.

Aprasia pulchella J. E. Gray, in G. Grey's Two Exped. Austr., ii, 1841, app. E, p. 428, pl. 4, fig. 2.

Aprasia pulchella Lutkën, Vidensk. Meddel., 1862, p. 300, pl. 1, fig. 3.

Aprasia octolineata Peters, Monatsb. Akad. Wiss. Berl., 1863, p. 233.

Aprasia pulchella Gunther, Ann. Mag. Nat. Hist. (4), xii, 1873, p. 145.

Aprasia pulchella Boulenger, Brit. Mus. Cat. Liz., i, 1885, p. 246.

Aprasia pulchella McCoy, Prod. Zool. Victoria, ii, 17, 1888, p. 233, pl. 162, fig. 1.

Aprasia pulchella Werner, K. Pr. Akad. Wiss. Berl., Das Tierreich, Lief. 33, 1912, p. 25, figs. 1-3.

Fig. 7.

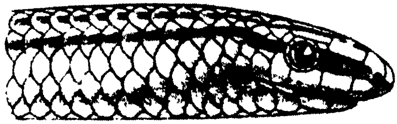


Fig. 8.

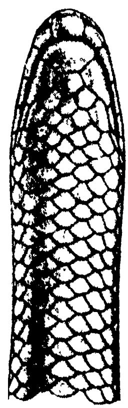


Fig. 9.

After McCoy.

Snout projecting beyond the lower jaw, rounded, eye well developed, its diameter larger than its distance from the mouth. Eyelid rudimentary, a circular scaly ring. Tail shorter than body, subequal in diameter throughout, the lip being obtuse and rounded. Three or four anal scales, the central ones either elongated transversely or triangular. Rudiments of hind limb extremely small, and hardly visible. Rostral broader than long or higher than broad, visible from above. Nostril situated in very large nasals, either isolated or connected with second upper labial by a suture. The nostrils form a suture on the top of the snout and fuse with the first upper labial, thereby reaching the lip. There is one preocular, one postocular scale, five or six upper labials, the third and fourth bordering the eye, and two or three lower labials. The inter nasals are absent, the frontal is large, twice or more times as broad as the supraoculars, about $1\frac{1}{2}$ times as long as broad, and as long as, or longer than its distance from the end of the snout. Its sides may be parallel or diverging posteriorly or anteriorly; it is six-sided, the anterior being angular and the posterior broadly rounded.

The parietal shields are absent, but the parietal scales are slightly larger than those on the occiput. Mental large, broadly trapezoid. Twelve or more series of scales around the body. Head shields here and there covered with minute pits.

Colour.—Yellowish above and below with a number of longitudinal (generally 8) dark brown lines formed by series of dots.

Localities of Specimens Examined.—One from West Arthur, via Wagin, W.A. Thirteen from "Australia," but there is no reason to doubt that they came from Western Australia.

Type in British Museum.

COMPARATIVE.

Of the fourteen specimens of *A. pulchella*, seven have twelve rows of scales round the body, the rest fourteen rows. Apart from this variation in the number of scales, the characters are fairly constant and warrant placing all the specimens under one species.

General.—Comparative details of the characters may be given as follows:—In all the specimens parietal scales are slightly larger than those on the occiput There may be three or four anal scales, which may vary in size and shape, but in no way does the variation appear to be characteristic of a group. This same may be applied to *A. repens* and *O. nasutus*. There may be three triangular, or two enlarged rather rounded scales, bordered in each case by small ones. Throughout the series there is one preocular and one postocular, the latter separating the fourth upper labial from the supraocular; this I have used as a specific character in the key. One abnormal specimen has two preoculars and one postocular on one side of the head and two postoculars on the other.

Shape of the Snout.—This is slightly variable; it may be indistinctly trilobed or bluntly rounded, and in the latter case, which is most general, it may be said to be almost angular; the rostral is visible from above, the size of the portion visible varying slightly in different specimens; it may be higher than broad or as broad as high; in some cases it gradually narrows from the lower angles to the apex, while in others the sides are parallel for a short distance and then converge to the apex.

Nostrils.—These are situated in the large nasals, which form a suture on the snout, thus excluding the internasals (which are absent), and they fuse with the first upper labial, appearing to reach the lip; the nostril may be isolated or connected with the second upper labial by a suture.

Labials.—There may be five or six lower labials, and the third and fourth upper labials border the eye.

In the following paragraphs, wherever the first upper labial is mentioned, I mean that one which is joined with, and which in some cases cannot be distinguished from the lower half of the nasal.

Frontal Shield.—The frontal shows little variation in adult specimens, more in the young; it is generally about twice as broad as the supraocular though never less, and it may be as long as, or longer than its distance from the end of the snout. On an average it is about $1\frac{1}{2}$ times as long as broad, and may be broader in front than behind, or vice-versa, or equal in measurement across the anterior and posterior portion. It is obtusely angular anteriorly and broadly rounded posteriorly.

The head shields are here and there (especially the anterior ones) covered with minute pits. These have been described as papillæ.

APRASIA REPENS *Fry.*

Ophioseps repens Fry, Rec. W. Austr. Mus., i, 1912, pp. 178-182, text figures.

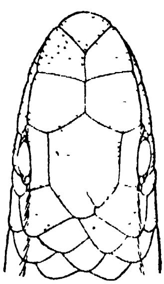


Fig. 10.

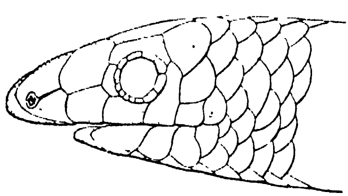


Fig. 11.

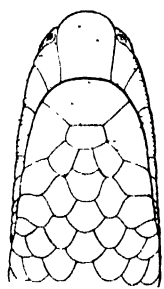


Fig. 12.

After Fry.

Snout projecting, slightly hooked and trilobed; a little more than three times the diameter of the eye. Eye considerably longer than its distance from the mouth, surrounded by a ring of small scales, of which the posterior are the largest. Portion of the rostral seen from above is once and one-half as long as its distance from the frontal, once and a quarter as broad as long, as long as the diameter of the eye; the portion seen from below longer than broad and slightly narrower behind than in front. Nasals apparently fused with the first supralabial of each side, in contact behind the rostral; a little shorter than the prefrontals, their suture being the same length as that of the prefrontals. Nostril large, not visible from above; a very distinct groove runs from its posterior edge to the lower anterior border of the prefrontal. Prefrontals a little larger than the nasals, a little more than half the length of the frontal, forming a suture in the median line and with the second supralabial. Frontal six-sided; broader in front than behind; almost once and a half as long as broad, as long as its distance from the end of the snout. Supraocular narrow, extending down behind the eye and meeting the third supralabial. A pair of parietal shields larger than the adjoining scales, in contact behind the eye with the third supralabial. A small preocular, no postocular. Five supralabials, four of them being distinct, the fourth very high and band-like, in contact behind the eye with the supraocular and the parietal scale, the fifth smallest, squarish. Mental large, almost twice as broad as long. Four sublabials, the anterior pair the largest and separated from each other in the median line by a small shield, which is followed by three others, the middle one of which is the smallest. Head shields thickly dotted with minute papillae. Scales smooth, Typhlops-like, in twelve series round the body. Preanals not enlarged. No external rudiments of limbs. Tail one-third as long as the body, terminating in a circular scale.

Colour (spirits). Body light greyish-brown above, slightly lighter beneath. Longitudinal rows of faint spots on the dorsal and lateral scales, these spots fainter and the rows more numerous on the sides. Head-shields with faint brown marks. Tail yellowish, the rows of spots of a reddish colour. Total length 145 mm. Tail 45 mm.

Type in Western Australian Museum, reg. no. R.364.

Described from a single specimen from Western Australia, without exact locality.

COMPARATIVE.

The eleven specimens which have no postocular and in which the diameter of the eye is equal to three or more times the length of the snout, and which (with the exception of three specimens too small to be examined) have teeth in the upper jaw, I have placed as *Aprasia repens* Fry. The various characters may be enumerated as follows:—

There are no ordinary enlarged parietal shields but the parietal scales are invariably larger than the surrounding occipital scales. The anals show but little variation; there may be one long transverse scale with a small one at each end; or the central one may be a little smaller and the outer ones slightly larger. There is one preocular and no postocular, thereby allowing the fourth upper labial to join the supraocular.

Shape of Snout.—This, which may be slightly or distinctly trilobed, is never rounded or angulate as in *A. pulchella.* The nostril suture connects with the prefrontal in all the specimens, and never with the second upper labial as in *A. pulchella.* The enlarged nasals form a suture with the first upper labial, thus giving the appearance of a nasal reaching the lip.

As in *A. pulchella,* the internasals are absent.

Frontal Shield.—This may be as long as, or slightly longer than, its distance from the snout, it is about twice as broad as the supraocular, but may be a little more in some specimens; in the adults it is obtuse-angled in front and rounded behind as in *A. pulchella,* but in the very young specimens the posterior border is produced backwards forming a narrower portion, as if squeezed in on each side. Several specimens bear a small hard clasp or spur on each side of the vent, in addition to the rudiments of the hind limbs which appear as soft loose scales; evidently those with the hard clasps are males, but the presence or absence of these does not appear to have any bearing on the type of scaling in respect to the preanals.

The eye is much larger than its distance from the snout, and is about equal to two-thirds the distance between them. Many of the head shields, especially the anterior ones, are covered with minute pits, these having been described by Fry as papillæ.

Localities.

Of the series examined three specimens are from Bumbleyung, W.A.; one from Fremantle; one from Cottesloe, W.A.; one from Midland Junction; and two, including Fry's type of *O. repens,* are labelled W. Australia. Three without locality no doubt come from West Australia.

A NEW VARANUS FROM COQUET ISLAND, QUEENSLAND.

By

J. R. Kinghorn, Zoologist.

(Plates xvii-xviii.)

Varanus boulengeri *sp. nov.*

Varanus sp. De Vis. Proc. Linn. Soc. N.S.W. (2), i, 1887, p. 1137.
Varanus sp. nov. Boulenger. Zool. Record, 1887 (Reptilia), p. 11.

Teeth obtuse, inclined to be conical. Snout broad, as long as the distance from the anterior angle of the orbit to the anterior angle of the ear orifice. Canthus rostralis obtuse, indistinct. Nostril broadly oval, almost circular, situated nearer the tip of the snout than the eye. The distance from the eye to the centre of nostril is 9.5 mm. and from the nostril to the snout 8 mm. Ear opening oblique, about as large as the eye. Scales of head, including supraoculars, flat, smooth, irregular in shape and size, the larger ones being situated round about the central line. Scales on occipital regions smaller than those on fore part of head, but larger than the temporals. Lower eyelid scaly, the scales of the central horizontal line being largest and dark coloured. Scales of dorsal surface smallest on neck, largest towards the tail; they are broadly oval in shape, smooth, and more or less flattened, though those on the neck are strongly convex. Lower labial and chin scales largest on the outside, becoming gradually smaller towards the mental groove, and larger again towards the nuchal fold where they are smallest. Abdominal scales large, rectangular, longer than broad, disposed in 74 rows from nuchal fold to groin. These scales are, here and there, incompletely separated, giving the under surface the appearance of having transverse folds of the skin, each fold bearing many incomplete grooves. Feet slender, third and fourth fingers subequal, the fourth not as long as the distance from the eye to the snout. Tail cylindrical and somewhat depressed at base, but becoming laterally compressed and keeled towards the tip. Scales of dorsal surface of tail more or less flattened at base, like those on body, but keeled towards the tip. Scales of ventral surface of tail similar at the base to those of the abdomen, but becoming more elongate and strongly keeled posteriorly.

Colour (in spirits).—Limbs and dorsal surface light grey, covered with dark, almost black blotches, which here and there tend to form irregular transverse bars. The upper surface of the head is suffused with a brownish tinge. Under surface yellowish, crossed here and there by indistinct, pale grey cross bars. Chin, throat, and sides of neck spotted. Tail marked at the base much the same as the body, but becoming more uniformly coloured towards the tip.

Locality.—Holotype from Coquet Island, Howick Group, Queensland, lat. 14° S., long. 144° E. The two other specimens before me, R.6144 and R.6735, are both from Townsville, Queensland.

Holotype.—Register number R.8083, Australian Museum.

The measurements of the specimens are given below in millimetres:

	Holotype.	R.6735.	R6144
Snout to vent	195	234	245
Vent to tip of tail	145	315	340
Length of head	39	41	42
Greatest breadth of head	27	28	28
Breadth of nostrils	13	13.5	13.5
Depth at eyes	15	17	17
Fore limb and claws	47	57	61
Hind limb	65	78	78
Length of eye	6	8	7
Scales around body	98	102	99
Longitudinal abdominal rows ..	74	80	84
Total length	440	549	585

De Vis[1] in describing a specimen from Herbert River, Queensland, had a suspicion that it might have been a local variety of *Varanus prasinus*, or at least a new record, as the latter is not known to occur nearer to Australia than some of the islands of Torres Strait, but he did not attempt to name it or suggest that it was a new species. Later, Mr. Boulenger recorded De Vis' find as a new species; he also refrained from attaching a name, evidently because he did not have access to the specimen. As I have not seen this specimen, I can only suggest that, from the description given by De Vis, it is identical with those before me, and therefore I am pleased to be able to give it a name which will in some way associate its founding with Mr. Boulenger, who was the first to suggest that it was new.

The specimens before me differ from *V. prasinus* in more than half a dozen good characters, as a perusal of the descriptions and a glance at the figures will show.

The holotype was collected by Mr. C. Hedley, and I am indebted to him for references to various notes dating back to the time of Captain Cook and Sir Joseph Banks. Cook[2] landed on an island about 20 miles south-east of Coquet Island, and, seeing there many lizards of large size, named the locality Lizard Island. It is recorded that some of them were captured, but I can find no reference to their being described. In 1901 Dr. A. E. Finckh[3] visited the island, and brought back a collection which comprised four species of *Lygosoma*, but he

[1] De Vis—loc. cit.

[2] Hawkesworth—Account of the voyages undertaken . . . for making discoveries in the Southern Hemisphere, and successively performed by Commodore Byron, Captain Wallis, Captain Carteret, and Captain Cook, in the *Dolphin*, the *Swallow*, and the *Endeavour*. . . . Vol. iii, 1773, p. 598.

[3] Johnston—Proc. Linn. Soc. N.S.W., (2) xxvi, 1901, p. 214.

did not see any trace of larger lizards such as *Varanus.* As Cook does not say just how big the lizards on the island were, I venture to suggest that they were either identical with, or closely allied to, the species described in this paper from Coquet Island.

Mr. Hedley informed me that the lizard was found running along the beach.

THE LARGEST HIPPOPUS.

By

Charles Hedley.

Interesting data relating to the size attained by the great Clams was published by the late Mr. Edgar Smith.[1] He observed that the British Museum had recently acquired from the Philippine Islands a specimen of *Hippopus hippopus* which was $13\frac{1}{4}$ ins. long 16 lbs. 9 ozs. in weight and far exceeded in size the largest specimen previously known.

But these dimensions again are exceeded by a shell which, in company with Dr. H. A. Pilsbry, I obtained alive on September 14th, 1923, at low tide on the Pandora Reef, near Palm Islands, off the coast of Queensland, in about 18″ 50° S. Lat. This individual weighs 28 lbs. 9 oz., and is $15\frac{3}{8}$ inches in total length, $10\frac{3}{4}$ in height, and $10\frac{3}{16}$ in breadth of conjoined valves. With increase of age, this species becomes more inequilateral by disproportionate increase of the posterior end, also the beaks become greatly incurved.

Since writing the above, Mr. H. A. Longman kindly informs me that he has in the Queensland Museum, an *H. hippopus* from Orpheus Island, Queensland, which is 41 lbs. in weight when cleaned, and is $18\frac{5}{16}$ inches in length between parallels.

[1] Smith, Proc. Malac. Soc. iii, 1898, p. 111.

A SUPPOSED MOLLUSCAN EGG-NIDUS.

By

CHARLES HEDLEY.

(Figure 1.)

A curious article was collected in March, 1923, on the beach at Cronulla, New South Wales, and sent for identification to the Museum by Mr. Adam Broadfoot.

It consists of a band of sand grains glued together and spirally rolled into the shape of a bowl open at the bottom. This coil overlaps for half a whorl or more, is grey speckled with black, thin and friable, in texture like a Scotch oat-cake. The base is contracted, evenly truncated with a vertical edge, the middle is bulged out, and the upper rim is vertical, frilled or ragged. In diameter the top is 55 mm., the base 30 mm., and the height is 30 mm.

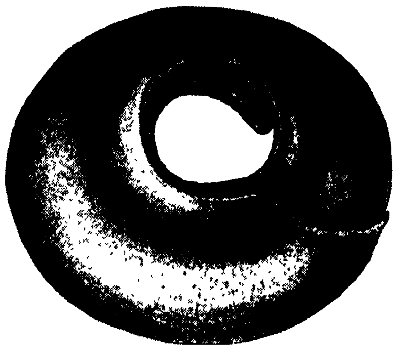


Fig. 1.

This object has so close a resemblance to the egg-nidus of *Natica* described by European authors as to suggest that it may be the product of *Polinices aulacoglossa*. Different species probably construct their nidus on a slightly different pattern.

As I cannot detect in this mass any molluscan eggs, I am unable to determine its nature satisfactorily. This account is penned to invite scientific beach-combers to investigate the subject further.

Literature on *Natica nidus* is as follows:

Hogg, J.—Trans. Linn. Soc. Lond. xiv, 1825, pp. 318-321, pl. ix, figs. 1-8. Reviewing previous literature.

Forbes, E., and Hanley, S.– Hist. Brit. Moll iii, 1853, p. 328.

Harvey, W. H.—The Sea-side Book, 4th ed., 1857, p. 65.

Jeffreys, J. G.—Brit. Conch., iv, 1867, pp. 213, 222.

Gould, A. A.—Invert. Massachusetts, 1870, p. 339.

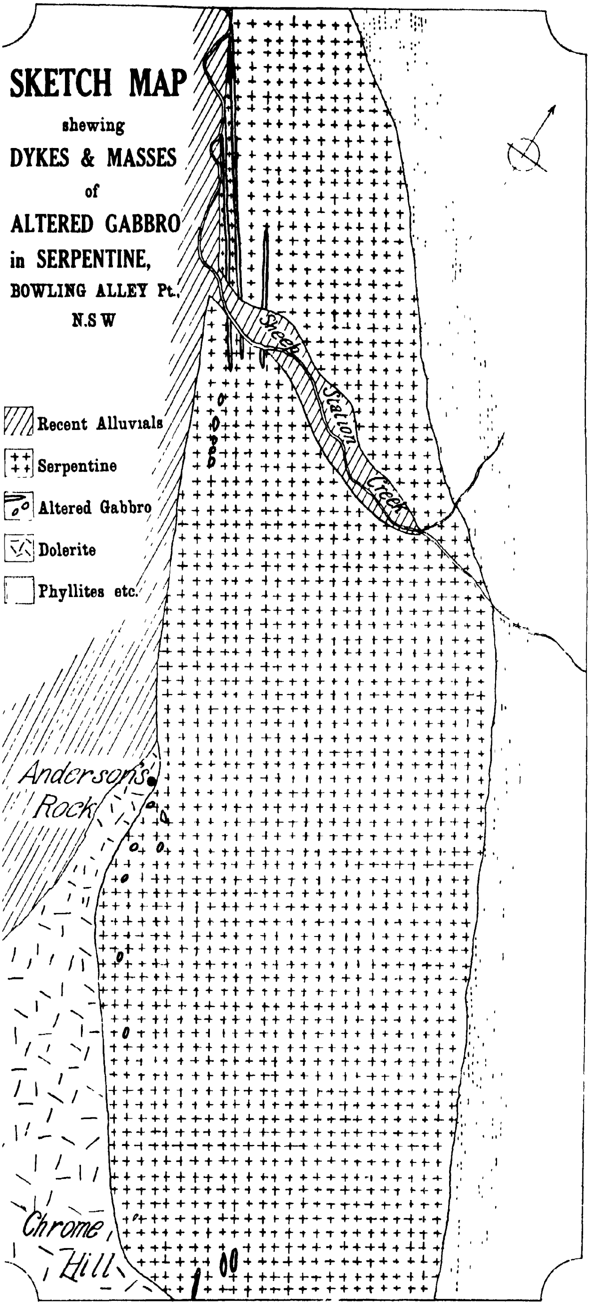
Cooke, A. H.—Molluscs, Camb. Nat. Hist., iii, 1895, p. 126, text fig. 41; copied by Simroth, Bronn's Tierr-Reichs, Mollusca iii, 1907, pl. 46, fig. 12.

White, B. C.—Marvels of the Universe, ii, n.d., p. 776, text fig. "A sand saucer."

EXPLANATION OF PLATE XII.

Sketch Map, showing dykes and masses of altered Gabbro in Serpentine, Bowling Alley Point, near Nundle, New South Wales.

Scale: 1 inch = 16 chains.



T. HODGE SMITH, del.

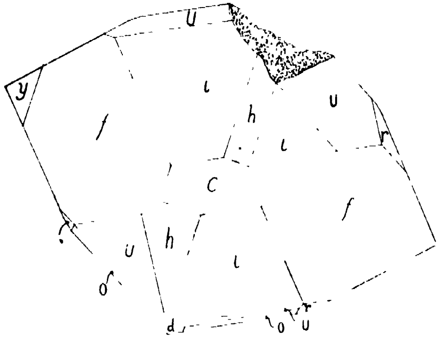
EXPLANATION OF PLATE XIII.

Figs. 1-4. Topaz, Blatherarm Creek, Torrington, New South Wales.

Forms: *c* (001), *m* (110), *M* (230), *l* (120), *g* (130), *n* (140), *d* (201), *h* (203), *o* (221), *u* (111), *i* (223).

Fig. 5. Quartz, Tingha, New South Wales.

Forms: *r* $(10\bar{1}1)$, *z* (0111), *c* (6061), *i* $(50\bar{5}3)$, *s* $(21\bar{1}2)$, *x* $(6\bar{1}\bar{5}1)$, ϕ $(71\bar{6}3)$.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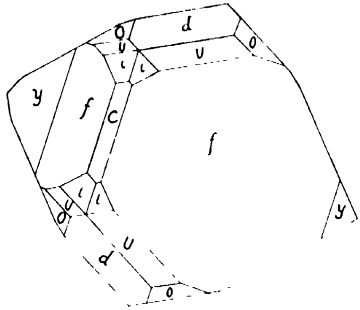
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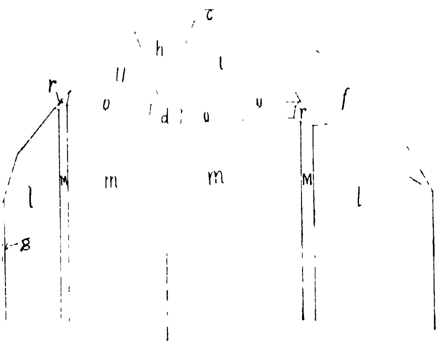
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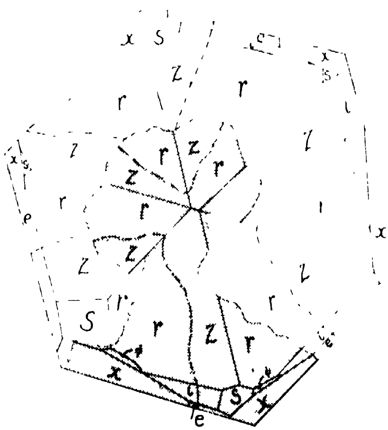
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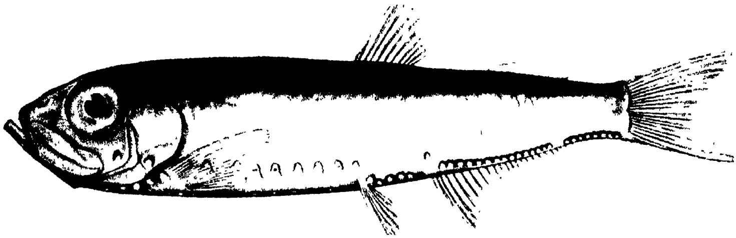
T. HODGE SMITH, del.

EXPLANATION OF PLATE XIV.

Fig. 1. *Maurolicus pennanti australis* Hector. A specimen 54 mm. long, from the Province of Canterbury, New Zealand.

„ 2. *Lampanyctus townsendi* Eigen. and Eigen. A specimen 65 mm. long, from Lord Howe Island. The distribution of the luminous scales as here illustrated has been determined by the aid of other specimens from the same locality.

„ 3. *Argyropelecus amabilis* Ogilby. Lectotype of *Sternoptychides amabilis*, 42 mm. long, without the tail, from Lord Howe Island.



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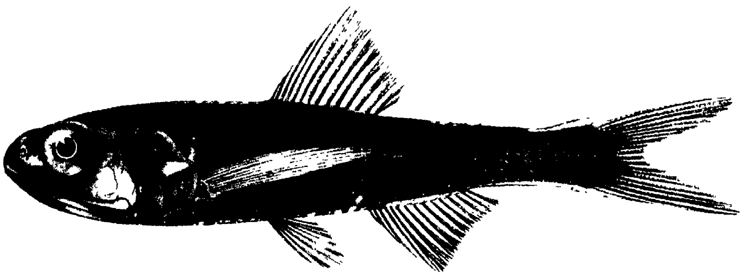

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3

A. R. McCulloch, del.

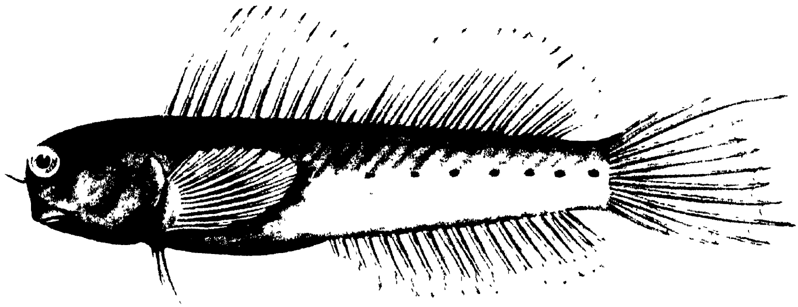
EXPLANATION OF PLATE XV.

Fig. 1. *Ecsenius mandibularis* McCulloch. Male, Holotype, 64 mm. long, from Masthead Island, off Port Curtis, Queensland.

,, 2a. *Ecsenius mandibularis* McCulloch. Female, Paratype, 53 mm. long, from Masthead Island, off Port Curtis, Queensland.

,, 2b. *Ecsenius mandibularis* McCulloch. Mandibular dentition, showing anterior and lateral teeth.

,, 3. *Salarias fasciatus* Bloch. A specimen 69 mm. long, from Two Isles, off Cape Bedford, Queensland.



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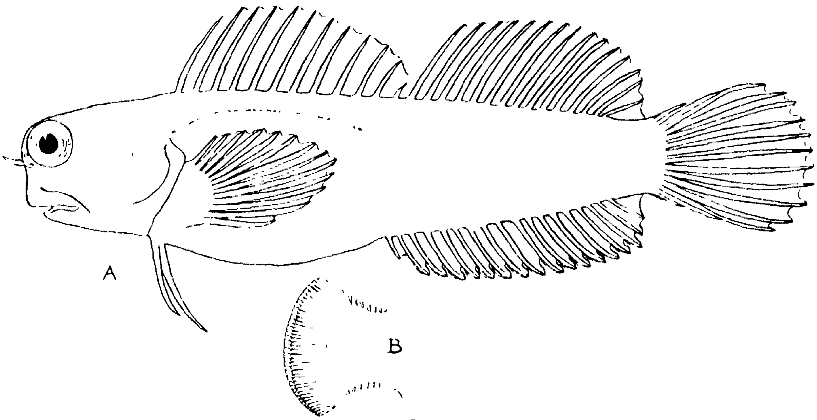

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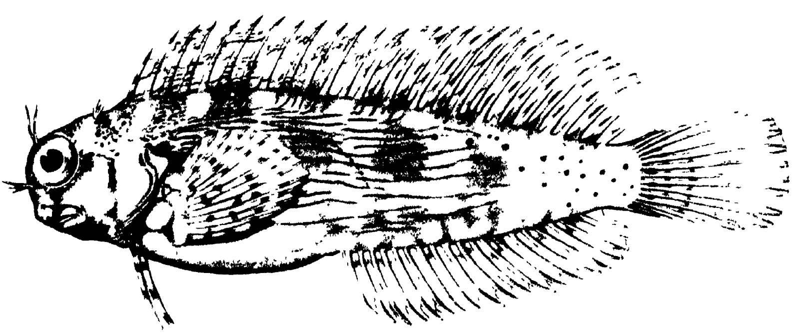

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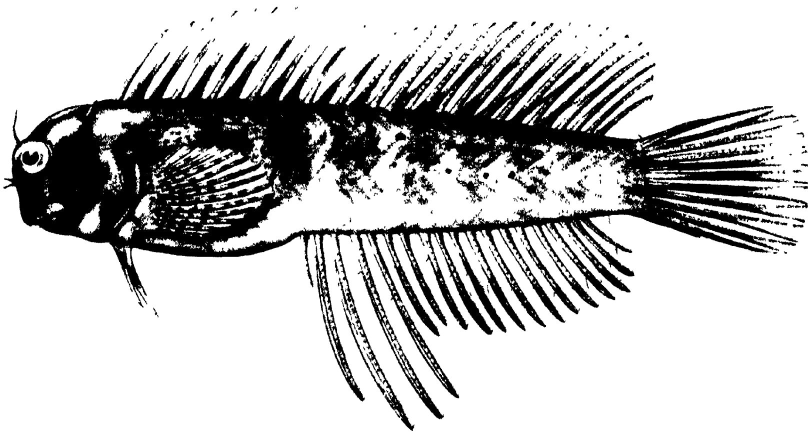
A. R. McCulloch and F. A. McNeill, del.

EXPLANATION OF PLATE XVI.

Fig. 1. *Salarias crenulatus* Weber. A male, 79 mm. long, from Masthead Island, off Port Curtis, Queensland.

,, 2. *Salarias crenulatus*, Weber. A female, 66 mm. long, from Masthead Island, off Port Curtis, Queensland.

,, 3. *Rainfordia opercularis* McCulloch. Holotype, 124 mm. long, from Whitsunday Passage, Queensland.



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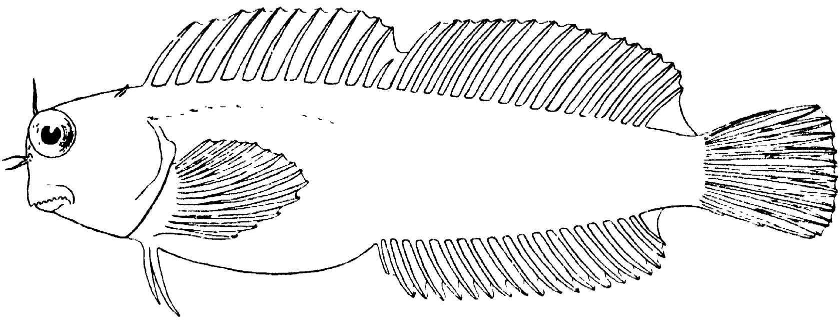

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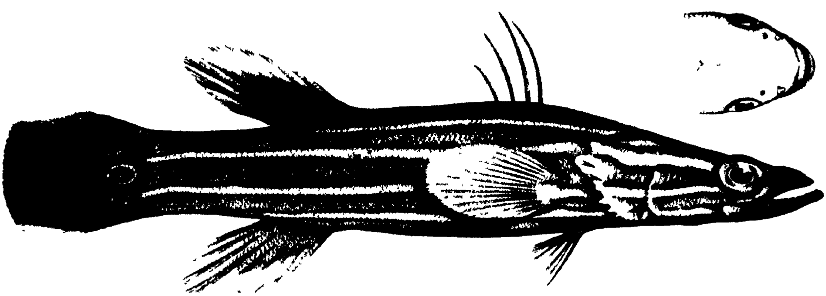

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A. R. McCulloch and F. A. McNeill, del.

EXPLANATION OF PLATE XVII.

Varanus boulengeri, sp. nov. Holotype, natural size, from Coquet Island, Howick Group, Queensland, long. 144° E., lat. 14° S.

G. C. CLUTTON, photo.

EXPLANATION OF PLATE XVIII.

Varanus boulengeri sp. nov.

Holotype.

Fig. 1. Lateral view of head showing comparative distances between ear, eye, nostril and snout. Magnified × 2

„ 2. Dorsal view of head showing size and arrangement of scales. Magnified × 2.

„ 3. Dorsal scales. Magnified × 4.

„ 4. Lateral view of mid section of tail. Magnified × 4.

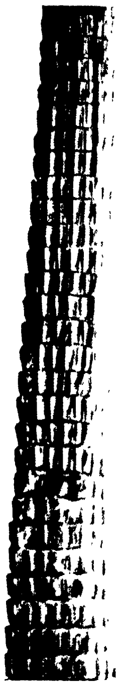
„ 5. Left hand. Magnified × 2.

„ 6. Section of abdominal scales. Magnified × 2.

1

2

3



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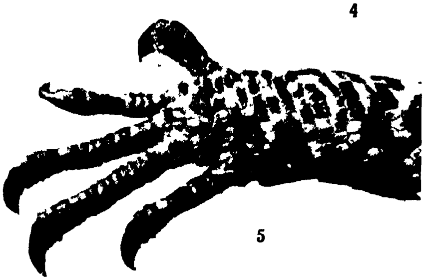

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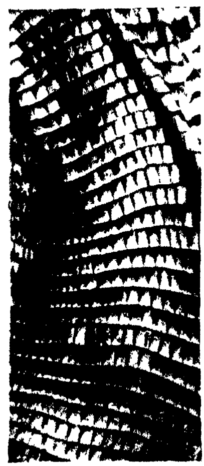

6

G. C. CLUTTON, photo.

A REVISION OF THE AUSTRALIAN PINNIDÆ.

By

CHARLES HEDLEY.

(Plates xix-xxi.)

The Pinnidæ are a small family of marine bivalves including many fossil and about fifty recent species which occur throughout the warmer seas of the world. Though thin and brittle these shells are notable for their length, being exceeded in this respect only by the Giant Clams. They live planted point downwards with the tips of the broad ends projecting above the surface of zostera flats. An ugly wound may be inflicted on the bare feet of those who tread on their sharp blades, from this the shells are called in Australia "Razorbacks." The doings of a commensal crab, *Pinnotheres*, frequently a guest in the *Pinna* mansion, is related by classic legends either as the behaviour of a rascal or of a grateful attendant.

The first attempt at classification of the Pinnidæ was by Chemnitz, who in 1785 drew attention to a feature separating various species of *Pinna*. In some, for instance *P. incurvata*, the apical muscle scar has a ridge running lengthwise down the centre; in others, as in *P. atrata*, this ridge is absent. Apparently prompted by this observation, Gray proposed[1] the genus *Atrina* for the second group, with *P. nigra* for type. As the basis of this genus he cited "1844." This has been shown by Iredale to indicate the following passage,—"The *Pinna* have an elongated shell with a longitudinal crack filled with a cartilage in the middle of each valve, and *Atrina* are shorter shells without any such crack.—Gray, Synopsis of the Contents of the British Museum, 44th Edition, 1842, p. 83." Iredale[2] advises that the name *Atrina* should date from the nomination of a type in November, 1847.

This classification was expanded first by the Adams brothers and then more fully by Dr. E. von Martens[3]. As the latter has explained, the feature noted by Chemnitz is comparatively trivial. The essential characters of *Pinna* are that the shoulder of the shell towards the apex is externally angled and fissured, while that of *Atrina* is rounded and entire; inside the valve, *Pinna* has a long narrow sinus which extends through the middle of the nacreous tract for most of its length, while the nacreous tract of *Atrina* is not thus cleft. These features are contrasted in Pl. xix, fig. 3 and Pl. xx, fig. 12 of the present paper.

An excellent account of the structure and habits of *Atrina* is given by Grave[4].

[1] Gray—Proc. Zool. Soc., 1847, p. 199.
[2] Iredale—Proc. Malac. Soc., x, 1913, pp. 294-309.
[3] Von Martens—Ann. Mag. Nat. Hist., (3), xvii, 1866, pp. 81 88.
[4] Grave—U.S. Fisheries Bureau, Bull. xxix, 1911, pp. 411-439, pl. 48-50.

Suter[5] has unfortunately transferred *Pinna zelandica* Gray, to *Atrina*, whereas it really is, as Gray said, a *Pinna*. On the other hand, *P. senticosa* Gould is probably an *Atrina*.

Probably *Pinna* is more modified and *Atrina* the more primitive form.

By Lamarck in 1799 and again by Gray in 1847 the type of *Pinna* was indicated to be *Pinna rudis*, the first of the genus in the Linnean presentation. This genotype has been so generally misconstrued that it is worth attention. In the tenth edition of the "Systema Natura," Linné introduced *Pinna rudis*, basing it on two discordant figures, the first being "Rumph. mus. t.46.f.L. Pinna lata." a broad black shell from Amboyna; the second was "Argenv. Conch. t.25.f.F. Perna." a narrow horn-coloured eight-ribbed shell from an unknown locality. Six years later the same quotations were repeated for *P. rudis* in the Museum of Queen Ulrica. But in 1767, in the twelfth edition of the "Systema," another reference was added, "Ginan. adr. 2.t.25.f.116." being a species from the Adriatic, scored with twenty longitudinal furrows, and which agreed with neither of the others.

Though not included in the original party, Lamarck[6] misinterpreted the Red Ham shell from the West Indies, so well figured by Chemnitz[7] as being the Linnean *P. rudis*. Dispossessed of this title, the Red Ham shell may now resume its proper name of *Pinna ferruginea* Bolten.

Bolten[8] fixed this name on *Pinna nigra* of Chemnitz while Dr. Gwyn Jeffreys[9] stoutly contended that *Pinna rudis* meant the British shell. The controversy between candidates for the use of the name of *Pinna rudis* need not be followed further.

A final effort was made by Linné to compose the confusion that he had caused, for in his concluding notice of *P. rudis* he separated as variety *beta* the black shell from Amboyna. Because the description applies to the shell figured by Argenville and not to that of Rumphius, the former must carry the name of *Pinna rudis*. Hanley[10] wrote "Argenville's engraving is not so unlike the ideal, but was apparently drawn from a broken specimen; it has been quoted by Dillwyn for his *carnea*, and by Lamarck for his *flabellum*, which latter, purified in its synonymy, seems identical with the former." *Pinna carnea* (= *flabellum*) was recognised as a native of Porto Rico in the West Indies, by Dall and Simpson.[11]

[5] Suter—Manual of New Zealand Mollusca, 1913, p. 893.
[6] Lamarck—Syst. Anim. s. Vert., 1801, p. 112.
[7] Chemnitz—Conch. Cab., viii, 1785, p. 218, t. 88, fig. 773.
[8] Bolten—Mus. Bolt. (2), 1798, p. 159.
[9] Jeffreys—Journ. de Conch., xv, 1867, p. 230.
[10] Hanley—Ips. Linn. Conch., 1855, p. 148.
[11] Dall & Simpson—U.S. Fish Comm., Bull, xx, 1, 1900, p. 462.

Australian Fossils.

The following species of fossil Pinnidæ are noted as recorded from Australia.

Pinna australis Hudleston, from Western Australia.[12]

Pinna cordata Pritchard, from Victoria.[13]

Pinna inermis Tate, from South Australia.[14]

Pinna reticosa Chapman, from King Island, Tasmania.[15]

Atrina tateana nom. mut., from South Australia; as *Pinna semicostata* Tate[16] was pre-occupied by a recent species from the Hawaiian Islands, *Pinna semicostata* Conrad,[17] another name is here proposed.

Erroneous and Doubtful References.

Pinna ceylanica is recorded by Paetel[18] as from Australia. There is no such species.

Pinna cumingii is recorded by Reeve[19] as from Australia. It has not been observed since then from that locality. As Hanley in the original description wrote "Hab. Peruvia" that is more probable. But it is not included in Dall's list of Peruvian shells.[20]

Pinna magnifica is catalogued by Paetel[21] as from Australia. There is no such species.

Pinna pectinata is listed by Jay[22] as from New Holland. The species is European and the locality erroneous.

Pinna ramulosa is recorded by Clessin[23] as from Moreton Bay. This species was originally recorded from the West Indies. Clessin's error probably arose from the duplication of species 52 by Reeve.

Pinna rotundata is recorded by Menke[24] as from New Holland. Apparently this is an error of identification.

Pinna serrata is recorded by Hanley[25] as from New South Wales. This species belongs to the West Indies and the Australian reference is an error.

Pinna squamosa is recorded by Hanley[26] as from Australia. Apparently this is an error of identification.

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12 Hudleston—Geol. Mag., n.s., (3), vii, 1890, p. 241, pl. ix, fig. 6.
13 Pritchard—Proc. Roy. Soc. Victoria, n.s., vii, 1895, p. 228, pl. xii, figs. 4 5.
14 Chapman—Proc. Roy. Soc. Victoria, xxxii, 1920, p. 229.
15 Chapman—Mem. Nat. Mus. Melbourne, iv, 1912, p. 47, pl. vi, fig. 8.
16 Tate—Trans. Roy. Soc. S.A., viii, 1886, p. 122, pl. xiv, fig. 9, and op. cit. xxvii, 1899, p. 276.
17 Conrad—Journ. Acad. Nat. Sci. Philad., vii, 1837, p. 245, pl. 20, fig. 11.
18 Paetel—Cat. Conch. Samml., 1890, p. 209.
19 Reeve—Conch. Icon., xi, 1858, pl. xvi, fig. 29.
20 Dall—Proc. U.S. Nat. Mus., xxxviii, 1909, p. 254.
21 Paetel—Cat. Conch. Samml., 1890, p. 208.
22 Jay—Cat. Shells, 1839, p. 31.
23 Clessin—Conch. Cab., viii, 1891, p. 95.
24 Menke—Moll. Nov. Holl. Spm., 1843, p. 36.
25 Hanley—Cat. Rec. Bivalves, 1843, p. 252.
26 Hanley—Cat. Rec. Bivalves, 1843, p. 252.

Catalogue of Australian Species.

PINNA ATROPURPUREA *Sowerby.*

Pinna atropurpurea Sowerby, Tankerville Catalogue, p. 23, No. 531a appendix, p.v. 1825; *Id.*, Hanley, Cat. Rec. Bivalves, 1843, p. 255; *Id.*, Reeve, Conch. Icon., xi, 1858, pl. xxii, fig. 41; *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 87; *Id.*, Clessin, Conch. Cab., viii, 1890, p. 71, pl. 27, fig. 2.

Hab.—Queensland:—Cape Flattery (self).

This species has not been previously recorded from Australia. I found a single specimen alive on the sand flat under Cape Flattery in July, 1916.

PINNA ATTENUATA *Reeve.*

Pinna attenuata Reeve, Conch. Icon., xi, 1858, pl. xxiv, fig. 46. *Id.*, Clessin, Conch. Cab., viii, 1890, p. 59, pl. 27, fig. 1. *Id.*, Lynge, D. Kgl. Danske Vidensk. Selsk. Skrifter, 7, v, 1909, p. 149.

Pinna stutchburii Reeve, Conch. Icon., xi, 1859, pl. xxxiii, sp. 64. *Id.*, Pagenstecher in Kossmann, Zool. Ergebnisse, i (2), 1877, p. 31. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 87. *Id.*, Clessin, Conch. Cab., viii, 1891, p. 74, pl. 30, fig. 2.

Hab.—Queensland: Moreton Bay (type, S. Stutchbury.)

Von Martens has insisted that *P. stutchburii* is a synonym of *P. attenuata*, which he refers to a group *Cyrtopinna* proposed by Mörch[27] for *P. incurva*, Gmelin.

Reeve notes that the Queensland shell is called after an esteemed resident of Bristol, who had then (February, 1859) lately died. Stutchbury was once Government Geologist of New South Wales.

PINNA DOLABRATA *Lamarck.*

(Plate xx, fig. 9; plate xxi.)

Pinna sp., Peron, Voy. Terr. Austral., ii, 1816, p. 81.

Pinna dolabrata Lamarck, An. s. vert. vi, 1819, p. 133; *Id.*, Blainville Dict. Sci. Nat., xli, 1826, p. 69; *Id.*, Gray, in King's Survey, appendix ii, 1827, p. 478.

Pinna zeylanica Angas, Proc. Zool. Soc., 1865, p. 655 (not of Gray).

Pinna inermis Tate, Trans. Roy. Soc. S.A., ix, 1887, pp. 71, 107, pl. iv, fig. 5; *Id.*, Chapman, Proc. Roy. Soc. Victoria, xxxii, 1920, p. 229.

P. dolabrata, Clessin, Conch. Cab., 1890, p. 69.

[27] Mörch—Cat. Conch. Yoldi, 1852, p. 51.

Hab.—South Australia:—St. Vincent Gulf (Angas); Western Australia:—Eucla (Tate).

Under this name Lamarck described a fine *Pinna*, 14 inches long, which has been neglected by subsequent writers. His locality "? les mers australes," indicates Peron as the collector, because others of his shells were thus cited. The locality labels of Peron seem to have been usually defective. To give an idea of the form of *P. dolabrata*, Lamarck quoted a figure of Chemnitz which is something like it.

Peron himself writes that in January 1803 he found a large bed of *Pinna* in a sheltered bay of Kangaroo Island. The shells were sunk in a floor of sandy mud, covered by two feet of water at low tide and were so abundant that he could easily have collected thousands of them.

In shape this species resembles *P. madida*, but the radial ridges are always smaller and closer.

I enquired of M. Bedot, custodian of the Lamarck Collection in Geneva, if *P. dolabrata* was represented there. In reply he sent me very kindly the photographs reproduced in Pl. xxi, of a co-type of *P. dolabrata*, 215 mm. in length, 97 mm. in breadth and 29 mm. in thickness. These correspond so closely to the shell from Adelaide here figured that I am assured of their specific identity.

My other figure is from a specimen 11½ inches long, collected by Mr. Walton at the outer harbour of Adelaide, South Australia, and kindly forwarded by Dr. R. Pulleine.

PINNA FUMATA *Reeve.*

Pinna fumata Reeve, Conch. Icon., xi, May, 1858, pl. xv, fig. 27, 28. *Id.*, Hanley, Proc. Zool. Soc., Nov., 1858, p. 227. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 87. *Id.*, Melvill & Standen, Journ. Linn. Soc. Zool., xxvii, 1899, p. 184. *Id.*, Clessin, Conch. Cab., viii, 1890, p. 54, pl. xxii, fig. 1. *Id.*, Herdman, Report Pearl Fisheries Manaar, i, 1903, p. 37.

Hab.—Queensland:—Murray Island (Haddon); Northern Territory:—Darwin (W. H. Christie).

PINNA ISOSCELES, *sp. nov.*

(Plate xix, fig. 1.)

Shell small, subtriangular, nearly symmetrical, the ventral angle more rounded than the dorsal, almost twice as long as broad, moderately inflated. Colour, blackish brown shading anteriorly into russet and tawny olive. Sculpture:—there are seventeen low rounded equidistant ribs, parted by broader flat interstices, across the ribs

run a few distant series of scales; the ventral limb, extending for about a sixth of the height of the shell, is devoid of radial sculpture but has irregular concentric growth lines; under the lens the entire shell is densely microscopically shagreened. The adductor scars, parted by the usual *Pinna* sinus, are nacreous with a green reflection.

Length 160 mm., height 96 mm., depth of conjoined valves 22 mm.

Hab.—New South Wales:—Port Jackson, North Harbour (type, G. Besser); Sand flats at Gunnamatta Bay (F. A. McNeill); Lord Howe Island (W. R. B. Oliver and A. R. McCulloch).

This species has been misidentified as *Pinna zealandiæ* and *P. muricata*. The nearest ally is *Pinna semicostata* Conrad, of which the ventral limb, the space bare of radial riblets, is much broader.

The sculpture of *P. isosceles* distinguishes it from other wedge shaped *Pinnæ* such as *P. æquilatera* von Martens, *P. moluccensis* Clessin or *P. regia* Reeve.

PINNA MADIDA *Reeve.*

Pinna madida Reeve, Conch. Icon., xi, 1858, pl. xvii, fig. 31; *Id.*, von Martens, Ann. Mag. Nat. Hist., (3) xvii, 1866, p. 87. *Id.*, von Martens, Journ. Linn. Soc., Zool., xxi, 1889, p. 204. *Id.*, Clessin, Conch. Cab., viii, 1890, p. 70, pl. 25, fig. 2. *Id.*, Lynge, K. D. Vidensk. Selsk. Skr. vii, 1909, p. 149.

Pinna. sp. (?) Kent, Naturalist in Australia, 1897, p. 209, pl. xxxvi. *Id.*, Quoy and Gaimard, Zool. Astrolabe, iv, 1833, p. 317.

(?) *Pinna bicolor* var. Odhner, K. Sv. Vet. Akad., Handl., lii, 16, 1917, p. 7.

Hab.—Northern Territory:—Port Essington (type); Western Australia:—Broome (Mjöberg); Queensland:—Bowen (E. H. Rainford), Port Curtis (Austr. Mus.), Karumba in the Gulf of Carpentaria (C. Hedley).

From Bowen, Mr. E. H. Rainford has sent a pair of *P. madida*, twelve inches long and four broad, containing a commensal shrimp. This latter was afterwards determined by Dr. W. T. Calman of the British Museum as *Anchistus inermis* Miers. Perhaps the "small lobster-like crustacean" noted by Dr. Coppinger[28] as obtained by Haswell from a *Pinna* at Port Molle was the same *Anchistus*. Mr. E. J. Banfield[29] has already noted the commensals of a *Pinna* at Dunk Island, Queensland. The same writer has given a charming account[30] of a pearl which he saw in the waving mantle of a living *Pinna*.

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[28] Coppinger—Cruise of the "Alert", 1883, p. 187.
[29] Banfield—Confessions of a Beachcomber, 1908, p. 135.
[30] Banfield—Tropic Days, 1918, p. 211.

PINNA MENKEI *Reeve.*

(Plate xix, figs. 2-3.)

Pinna menkei Reeve, Conch. Icon., xi, June, 1858, pl. xviii, fig. 34. *Id.*, Hanley, Proc. Zool. Soc., Nov., 1858, p. 228. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 87. *Id.*, Whitelegge, Journ. Roy. Soc. N.S. Wales, xxiii, 1889, p. 244. *Id.*, Clessin, Conch. Cab., 1890, viii, p. 68, pl. 26, fig. 1. *Id.*, Roth, North Queensland Ethnography, Bull. iii, 1901, p. 8.

Pinna euglypta Reeve, Conch. Icon. xi, June, 1858, pl. xx, fig. 37, 38. *Id.*, Hanley, Proc. Zool. Soc., Nov., 1858, p. 228.

Pinna vespertina Reeve, Conch. Icon., xi, June, 1858, pl. xxiii, fig. 44.

Pinna zeylanica Angas (not Gray), Proc. Zool. Soc., 1867, p. 930.

The original figure of the type of *Pinna menkei* shows a shell distorted by injury. A specimen from Camden Haven, here figured, is 300 mm. in length and 130 mm. in height, but the species is frequently broader. The posterior ventral corner is always more rounded than the posterior dorsal. The colour may be monochrome or banded, and varies from chestnut-brown to tawny olive. The sculpture consists of about eighteen rounded low ribs parted by wider shallow interspaces; the radials decrease towards the posterior margin and vanish on the ventral limb and may be crossed by a concentric series of low scales. This seems to be a common shell in Queensland, which, exceptionally and in a dwarfed condition, may reach as far south as Sydney.

Hab.—New South Wales:—Port Jackson, Rose Bay (J. Brazier), Camden Haven, Gogley Island (Fishery Department); Queensland:—Stradbroke Island (Kesteven), Port Curtis (Museum Coll.), Cape Flattery (Hedley), Gulf of Carpentaria (W. E. Roth).

VAR. CAVITERGA, *var. nov.*

(Plate xx, fig. 8.)

The original of my figure was determined by Mr. E. A. Smith as "*Pinna menkei*, var." In colour and sculpture it corresponds to normal *P. menkei*, but differs in contour. The shape is nearly that of a battered wedge, the posterior end being broad and nearly square to the median line, the hinge line is concave, the dorsal margin meets the posterior almost at a right angle, but the posterior ventral is rounded. Length 230, breadth 145 mm.

Hab.—Queensland:—Fraser's Island (type); New South Wales:—Port Jackson (A. F. B. Hull).

Dr. W. H. Dall[31] has remarked how *Pinna* depends on environment. If the ground be hard and stony, the shells become short and wide and tend to be irregular or distorted; on soft ground they attain normal growth, inclining to be elongate, while in still water and on a sandy floor the scales and spines are most developed.

[31] Dall—Trans. Wagner Inst., iii, 1898, p. 664.

Pinna moluccensis *Clessin.*

Pinna mollucensis Clessin, Conch. Cab., viii, 1891, p. 82, pl. 33, fig. 1, *nom. mut.* for

Pinna angustana Reeve (non Lamarck), Conch. Icon. xi, 1858, pl. xxvi, fig. 51.

Pinna moluccensis correction Clessin, op. cit., p. 108.

Pinna angustata (sic.), Shirley, Proc. Roy. Soc. Queensland, xxiii, 1911, p. 94.

Hab. Queensland:—Torres Strait (Shirley).

There is in the Australian Museum a specimen of uncertain history, labelled "N.S. Wales" and determined in 1889 by Mr. E. A. Smith as *Pinna angustana.*

Pinna scapula *sp. nov.*

(Plate xix, figs. 6-7.)

Shell of moderate size, explanate spatuliform, unusually compressed and thin, dorsal margin concave, ventral margin sinuous, posterior margin broadly rounded. Colour:—interior, tawny olive with buff on the posterior edge; exterior, uniform fawn colour crossed by fine close concentric white lines. Sculpture:—the anterior quarter of the valve, the stalk of the leaf, has a low median fissured ridge, on the dorsal side of which are six sharp spaced elevated smooth cords which fade away posteriorly, on the ventral side are spaced concentric ridges which become smaller, closer, and finally disappear. The greater part of the disk is flat and featureless; on the posterior margin are a few imbricating lamellæ. The adductor scars are divided by the non-nacreous sinus characteristic of *Pinna.* The truncate posterior extremity is stoppered by a series of imbricating concave scales commencing about 7 mm. within the decollate apex.

Maximum length 244 mm., maximum height 132 mm., length of hinge line 140 mm., depth of single valve 13 mm.

This species is remarkable for its thin and leaf-like form and for the broad curve of the posterior end. The extraneous growth indicates that it was rooted no deeper than the byssal sinus.

Hab.—Northern Territory:—Darwin (W. H. Christie).

Pinna virgata *Menke.*

(Plate xix, figs. 4-5.)

Pinna virgata Menke, Moll. Nov. Holl. Spm., 1843, p. 36. *Id.*, Reeve, Conch. Icon., xi, 1858, pl. xxiv, fig. 45. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 87. *Id.*, Tate, Proc. Linn. Soc. N.S. Wales, vi, 1881, p. 402. *Id.*, Clessin, Conch. Cab., viii, 1891, p. 100, pl. 45, fig. 1.

Von Martens has bracketed this with *P. menkei.* The illustration of *P. virgata* given by Reeve does not conform either in shape, colour, or sculpture to the description of Menke, so the identity of this shell is at present unsatisfactory.

A stunted shell sent to me under another name from South Australia by Sir Joseph Verco is here figured with the suggestion that it may represent the lost *P. virgata.* For it agrees with Menke's description in the wedge shape and the peculiar sculpture of small dense overlapping and arched scales, though the bright rusty red radial lines are absent. On the South Australian shell there are nine radial cords between the cardinal margin and the median crack.

Hab.— Western Australia (type); South Australia.

ATRINA ASSIMILIS *Reeve.*

Pinna assimilis Reeve, Conch. Icon., xi, August, 1858, pl. xxxi, fig. 59. *Id.*, Hanley, Proc. Zool. Soc., 1858, Nov., p. 255; *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 86. *Id.*, Clessin, Conch. Cab., viii, 1891, p. 97, pl. 46, fig. 1.

Hab.—Queensland:—Raine Island (type, Ince), Cairns (Allen); Northern Territory:—Port Essington (Hanley).

ATRINA CHEMNITZII *Hanley.*

Pinna pectinata Chemnitz, Conch. Cab., viii, 1758, p. 211, pl. 87, fig. 770 not *P. pectinata* Linne.

Pinna chemnitzii Hanley, Proc. Zool. Soc., 1858, July, p. 136. *Id.*, Reeve, Conch. Icon., xi, 1858, August, pl. xxix, fig. 55, loc. cit., pl. 1, fig. 1, Feb. 1859. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 86. *Id.*, Dunker, Index Moll. Mar. Jap., 1882, p. 231. *Id.*, Hidalgo, Journ. de Conch., xv, 1867, p. 170. *Id.*, Morlet, Journ. de Conch., xxix, 1889, p. 161. *Id.*, Clessin, Conch. Cab. viii, 1891, p. 95, pl. 42, fig. 2, pl. 43, fig. 1. *Id.*, Odhner, Kungl. Sv. Vet. Akad., Handl., lii, 1917, p. 7.

Pinna japonica Reeve, Conch. Icon., xi, 1858, August, pl. xxv, fig. 47. *Id.*, Lischke, Jap. Mar. Conch., i, 1869, p. 159. *Id.*, Hirase, Illustrations of a Thousand Shells, 1915, pl. 41, fig. 201.

Pinna sp., v. Martens, Preuss. Exped. Ost. Asien, i, 1867, p. 141 and Lischke, Mal. Blatt. xxiv, 1867, p. 179, *fide* von Martens, Zoological Record, 1867, p. 599.

Hab.—Western Australia:—Broome (Mjöberg).

ATRINA DELTODES *Menke.*

Pinna deltodes Menke, Moll. Nov. Holl. Spm., 1843, p. 37; *Id.*, Hanley Cat. Rec. Bivalve Shells, 1843, p. 256, footnote; *Id.*, Menke, Zeit. Malak., i, 1844, p. 63; *Id.*, Reeve, Conch. Icon. xi, 1858, pl. xxi, fig. 40; *Id.*, Tate, Proc. Linn. Soc. N.S. Wales, vi, 1881, p. 402; *Id.*, Clessin, Conch. Cab., viii, 1891, p. 80, pl. 31, fig. 2; *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, p. 86, 1866.

Hab.—Northern Territory:—Near the mouth of the Victoria River (type); Torres Strait:—Darnley Island (British Museum).

ATRINA GOULDII *Reeve.*

(Plate xx, figs. 11-12.)

Pinna gouldii Reeve, Conch. Icon., xi, May, 1858, pl. xi, fig. 21. *Id.*, Hanley, Proc. Zool. Soc. Nov., 1858, p. 255. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 86. *Id.*, Paetel, Cat. Conch. Samml., 1890, p. 208. *Id.*, Clessin, Conch. Cab., viii, 1891, p. 78, pl. 34, fig. 3.

Pinna vexillum Reeve, Conch. Icon., xi, 1858, pl. xix, fig. 36, not *P. vexillum* Born.

Brauer[32] approved Reeve's figure of *vexillum* as representing Born's species. But the difference in contour and sculpture is so obvious that I am unable to accept that assurance. The shell here figured is notable for its dark colour, smooth surface, and the shortness of the hinge line in comparison with the total length. I suppose it to be a smooth dark form of *A. gouldii*, but for verification, as the nomenclature is so confused, a description is now added.

Shell broadly wing-shaped, rather small, thin and translucent, compressed. General colour raisin-black, shaded to indian purple and clouded with buffy-brown. Dorsal margin comparatively short, being three-quarters of the total length and meeting the posterior margin at a right angle. Posterior end obliquely rounded, ventral side evenly curved, byssal insinuation slight. Surface in general smooth, sculptured by slight irregular concentric growth lines which are most apparent on the ventral limb. The radials consist of about eleven widely spaced riblets, which attain most prominence at about one-third of the length; they do not intrude on the ventral limb and gradually vanish towards the posterior end.

Greatest length 166 mm., dorsal margin 130 mm., greatest breadth 100 mm., depth of conjoined valves 33 mm.

Hab.—Australia (Paetel). The figured specimen is labelled "Queensland," but without details. The type was reported by Hanley from Amboyna. Other specimens in the Museum were collected at the Gilbert Islands by Dr. Mackellar.

32 Brauer—Sitz. k. Akad. Wiss., lxxvii, 1878, p. 28.

Atrina inflata *Dillwyn.*

Pinna inflata Dillwyn, Descr. Cat. i, 1817, p. 326, for Chemnitz Conch. Cab., viii, 1785, pl. 87, fig. 771. *Id.*, Hanley, Cat. Rec. Bivalves, 1843, p. 156 (not *Pinna inflata* Reeve, etc.).

Pinna pectinata var. *beta*, Gmelin, Syst. Nat. xiii, 1791, p. 3364.

Pinna vitrea Bolten, Mus. Bolt. (2), 1798, p. 159, not *P. vitrea* Gmelin op. cit. p. 3366.

Pinna hanleyi Reeve, Conch. Icon., xi, 1858, pl. viii, fig. 15. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 86.

Pinna serra Reeve, Conch. Icon., xi, 1858, pl. xxiii, fig. 43. *Id.*, Clessin, Conch. Cab., viii, 1890, p. 60, pl. 28, fig. 2. *Id.*, Smith, Proc. Zool. Soc., 1891, p. 433. *Id.*, Sowerby, Marine Shells of South Africa, Appendix, 1897, p. 27. *Id.*, Lynge, K.D. Vidensk. Selsk., 7, v, 1909, p. 149.

Pinna penna Reeve, Conch. Icon., xi, 1858, pl. xxi, fig. 40.

Pinna serrata Hedley, Proc. Linn. Soc. N.S.W., xxx, 1906, p. 537.

Young examples, 70-75 mm. in length from Darwin correspond well to Reeve's figure of *P. penna*. Misled by Hanley's reference[33] of *Pinna serrata* to New South Wales, I had confused that West Indian shell with the present species.

Hab.—Queensland:—Moreton Bay (type of *P. serra*), Keppell Bay (G. Gross); Northern Territory:—Darwin (W. H. Christie).

Atrina nigra *Dillwyn.*

Pinna nigricans Solander, Cat. Portland Mus., 1786, p. 147 *(Nom. nud.)*.

Pinna rudis Bolten, Mus. Bolt. (2), 1798, p. 159, for *Pinna nigra* Chemnitz, viii, p. 221, t. 88, f. 774, and vignette 15, fig. A (not *P. rudis*. Linné.)

Pinna nigra Dillwyn, Descrip. Cat. i, 1817, p. 325 (for the same figure of Chemnitz). *Id.*, Wood, Index Test., 1828, p. 71, pl. 12, fig. 2; *Id.*, Clessin, Conch. Cab., 1890, p. 65, pl. 21, fig. 2; *Id.*, Melvill & Standen, Journ. Linn. Soc. Zool., xxvii, 1899, p. 184. *Id.*, Lamy. Bull. Mus. Hist. Nat., xii, 1906, p. 313.

Pinna nigrina Lamarck, An. s. vert. vi, 1819, p. 134, and Encyclopédie Méth., pl. 199, fig. 1 a, b.

Hab.—Queensland:— Torres Strait (Haddon).

Dillwyn's *P. nigra*, a symmetrical tongue-shaped shell, has been confused by later writers with another black *Atrina* of different contour and it is doubtful if Melvill and Standen have correctly identified the shell which Professor Haddon collected in Torres Strait.

33 Hanley—Cat. Recent Bivalves, 1843, p. 254.

Atrina strangei *Reeve*.

(Plate xx, fig. 10.)

Pinna strangei Reeve, Conch. Icon. xi, Aug., 1858, pl. xxvii, sp. 52. *Id.*, Hanley, Proc. Zool. Soc., Nov., 1858, p. 254. *Id.*, von Martens, Ann. Mag. Nat. Hist., (3), xvii, 1866, p. 86. *Id.*, Clessin, Conch. Cab., viii, 1890-1, pp. 70 and 102, but not pl. 24, fig. 1 (*vexillum*).

Pinna hystrix Hanley, Proc. Zool. Soc., Nov. 9, 1858, p. 226. *Id.*, Reeve, Conch. Icon., xi, Index, 1859, for pl. xxxii, fig. 60. *Id.*, Pagenstecher in Kossmann Roth. Meer. gesamm. Moll., 1877, p. 30. *Id.*, Lynge, D.Kgl. Danske Vidensk. Selsk., Skripter 7, t. v, 1909, p. 149.

The vermiculate sculpture of the ventral limb contrasting with the sharp even radials of the rest of the disk and the proportion of height to length furnish good recognition marks. Von Martens, followed by Clessin, identified *strangei* with *vexillum* and united the variety *hystrix* to *saccata* of Chemnitz, both of which references seem to the writer to be erroneous. Specimens in this Museum from Moreton Bay exactly correspond to Reeve's figure. A shell 150 mm. in length taken in 25 fathoms off Norah Head is here figured. A valve from Ballina which develops scales on the distal radials thus approaches var. *hystrix*.

Hab.—Queensland:—Moreton Bay (type, F. Strange); New South Wales:—Ballina (Hedley), off Norah Head, 25 fathoms (McNeill & Livingstone).

Atrina tasmanica *Tenison Woods*.

(Plate xx, fig. 13.)

Pinna tasmanica Tenison Woods, Proc. Roy. Soc. Tasm., 1875 (March, 1876), p. 161 and 1877, p. 55. *Id.*, Smith. Chall. Zool. Rep., xiii, 1885, p. 283. *Id.*, Tate & May, Proc. Linn. Soc. N.S. Wales, xxvi. 1901, p. 440. *Id.*, Pritchard & Gatliff, Proc. Roy. Soc. Vict. (2), xvii, 1904, p. 258. *Id.*, May, Illustr. Index Tasm. Shells, 1923, pl. 3, fig. 1.

This species has not been previously noted from this State. Local specimens are 165 mm. in length, more arched on the dorsal margin and have more scales than typical shells. Colour clay, darkening to dusky brown on the apices. The riblets are half a dozen, widely spaced on the top side and another half dozen small and closely packed on the ventral limb; these carry at irregular intervals tall and subtubular scales.

Hab.—Tasmania:—North coast (type, Legrand), Port Sorrell (Miss Lodder), Circular Head (May); King Island (A. F. Basset Hull); Victoria:—Moncœur Island, 38, fathoms ("Challenger"); Sorrento, Western Port and Lakes Entrance (Pritchard); New South Wales:—Shoalhaven Bight, 15-45 fathoms ("Endeavour"), off Norah Head, 25 fathoms (McNeill & Livingstone).

VAR. DUMOSA *var. nov.*

Pinna tasmanica Tate, Trans. Roy. Soc. S.A., xi, 1889, p. 69.

South Australia:—Tapley Shoal, St. Vincent Gulf, 15 fathoms (Matthews & McDougall).

This western form is smaller than the type, length 130 mm., breadth 70 mm., and the sculpture is more thorny, there being seven rows of eight or nine erect scales, exclusive of the smaller scales on the ventral limb.

ATRINA VEXILLUM *Born.*

Pinna lata Rumphius, Amboin. Rareit., 1741, p. 154, pl. 46, fig. 1.

Pinna incurvata Gualtieri, Index Test., 1742, pl. 81.

Pinna rudis var. *beta*, Linné, Syst. Nat., xii, 1767, p. 1159.

Pinna vexillum Born, Index Mus. Caes. Vind., 1778, p. 118; *Id.*, Born, Mus. Caes. Vind. Test., 1780, p. 134, pl. vii, fig. 8; *Id.*, Chemnitz, Conch. Cab., viii, 1785, p. 238, pl. 91, fig. 783; *Id.*, Gmelin, Syst. Nat., xiii, 1791, p. 3366; *Id.*, Lamarck, An. s. vert. vi, 1819, p. 134; *Id.*, Blainville, Dict. Sci. Nat., xli, 1826, p. 70. *Id.*, Hanley, Cat. Rec. Bivalves, 1843, p. 254; *Id.*, Clessin, Conch. Cab., 1890, p. 66, pl. xix, fig. 3, pl. 24, fig. 1; not *P. vexillum* Reeve.

Pinna gubernaculum Bolten, Mus. Bolt. (2), 1798, p. 159.

Pinna nigrina Sowerby, Genera Shells, pt. 26, 1825, pl. 103; *Id.*, Reeve, Conch. Syst., i, 1841, p. 42, pl. 104; *Id.*, Chenu, Man. Conch., ii, 1862, p. 164, fig. 821; *Id.*, von Martens, (in part) Ann. Mag. Nat. Hist. (3), xvii, 1866, p. 86; *Id.*, Pilsbry, Mar. Moll. Japan, 1895, p. 147; *Id.*, von Martens, Rumphius Gedenboek, 1902, p. 128. Not *Pinna nigrina* Lamarck.

Pinna nigra Reeve, Conch. Icon. xi, 1858, pl. 3, sp. 4; *Id.*, Odhner, Kungl. Sv. Akad. Handl. lii, 1917, p. 7; *Id.*, Jones, Coral and Atolls, 1910, p. 348; *Id.*, Dautzenberg, Journ. de Conch., lxviii, 1923, p. 60. Not *P. nigra* Dillwyn.

Pinna sp. Encycl. Meth., pl. 199, fig. 2.

Hab.—Queensland:—Murray Island (Hedley); W. Australia:—Broome (Mjöberg). An example in this Museum from the Trobriand Islands is 12 inches long and 7 broad.

Jukes has noted[34] that the native names for the common *Pinna*, probably this species, were "mowba" on Darnley Island and "waggaer" on Cape York.

[34] Jukes—Voy. "Fly," ii, 1847, p. 286.

SOME NATICOIDS FROM QUEENSLAND.

By

CHARLES HEDLEY.

(Plate xxii.)

The identity of a series of tropical species of Naticoids is unsatisfactory because of defective treatment in Reeve's monograph of *Natica* in the "Conchologica Iconica," which has governed subsequent studies of this group.

To put taxonomy on a better basis, I have here reviewed the nomenclature of several obscure species, and to facilitate their recognition also present figures of them.

The first name given to a group, resembling the Linnean *Nerita mammilla*, of polished massive white or yellow shells, was Humphrey's *Uber*. *Uber flemingianum* Recluz, *jukesii* Reeve, *labyrintheum* Hedley, *mellosum* Hedley and *pyriforme* Recluz, can be associated together.

Those species associated with *U. pes-elephantis*, being large, massive shells with a wide umbilicus containing a stout spiral funicle, may be grouped under *Mammillaria*, Swainson; namely, *U. citrinum* Philippi, *columnare* Recluz, *powisianum* Recluz, and *pes-elephantis* Deshayes.

Lastly, those thinner ovate and variegated shells grouped round *Uber mammatum* can be ranked under *Mammilla* Schumacher; such are *Uber mammatum* Bolten, *melanostomoides* Quoy & Gaimard, *nuxcastaneum* Martyn, *opacum* Recluz, *sebæ* Recluz and *simiæ* Deshayes.

UBER *Humphrey*.

Uber Humphrey, Mus. Calonnianum, 1797, p. 21, first species and type *Nerita mammilla* Linné.

Albula Bolten Mus. Bolt. (2), 1798, p. 20, first species *Albula albumen* Linné (not *Albula* Gronovius, Zooph., i, 1763, p. 102).

Mammilla Schumacher Essai, 1817, p. 190, type *Mammilla fasciata* Schumacher.

Polinices Montfort Conch. Syst. ii, 1810, p. 222, type *Polinices albus* Montfort.

Mammillaria Swainson, Treat. Malac., 1840, p. 345, type *M. lactea* Swainson.

Naticaria Swainson, Treat. Malac, 1840, p. 345, type *N. melanostoma* Mart.

Mamma Mörch, Fortegnelse Hencks Conch., 1854, p. 9, first species and type *N. melanostoma* Lam.

Naticina Guilding, Trans. Linn. Soc., v. 1831, p. 30, type *N. lactea* Guilding.

Naticella Swainson, Treat. Malac., 1840, p. 345, type *N. aurantia* Mart. (not *Naticella* Munster, Beitr. Petref., iv. 1841).

Mr. T. Iredale kindly gives me the following note: "As an item of sentimental interest it may be noted that Meuschen, at that time a non-binomial writer, proposed in the "Naturforscher" (Halle) Vol. xiii, p. 85, 1779, to separate from the *Nerita* of ancient usage, the White Eggshell species (i.e., *Nerita mammilla* Linné) under the name *Neritoides*. A figure of the internal structure of the shell is given (pl. v, fig. 5) to contrast with similar figures of species of *Nerita* (s. str.) pl. v, fig. 2 c, d, 3 g, 4 h."

UBER CITRINUM *Philippi*.

(Plate xxii, fig. 8.)

Natica citrina Philippi, Zeit. Malak., 1851 (15 July, 1851), p. 49. *Id.*, Conch., Cab., 1852, p. 143, pl. 19, fig. 17.

Polinices citrinus Shirley, Proc. Roy. Soc. Queensland, xxiii, p. 98, 1911.

Natica mittrei Hombron & Jacquinot, Voy. Pol. Sud., 1853, p. 65, pl. 16, figs. 33-34.

Neverita albumen Brazier, Proc. Linn. Soc. N.S. Wales, i, 1877, p. 238 (not *Nerita albumen* Linn., Syst. Nat., x, 1758, p. 776).

? *Natica draparnaudii* Recluz, Journ. de Conch., ii, p. 198, pl. 5, fig. 11 (30 July, 1851). Not *N. draparnaudi* Reeve, Conch. Icon. ix, 1855, pl. xi, fig. 44.

The specimen here figured is 38 mm. in diameter and was collected 7/6/'23, by myself on Chapman Island, North Queensland, Lat. 12° 53′ S.

Hab.—Queensland:—Torres Strait (Shirley), Chapman Island, Murray Island (Hedley), Darnley Island, 30 fathoms (Brazier).

UBER COLUMNARE *Recluz*.

Natica columnaris Recluz, Journ. de Conch., i, p. 394 December, 1850. *Id.*, Reeve, Conch. Icon., ix, 1855, pl. v, fig. 19. *Id.*, Smith, Zool. Coll. "Alert" 1884, p. 57. *Id.*, Hidalgo, Cat. Mol. Test. Filip., 1905, p. 158.

Hab.—Queensland:—Torres Strait, Prince of Wales Channel, 9 fathoms (Coppinger).

UBER FLEMINGIANUM *Recluz.*

Natica flemingiana Recluz, Proc. Zool. Soc., 1843, p. 209 (June, 1844). *Id.*, Journ. de Conch., iii, 1852, p. 171, pl. 7, fig. 2 (operculum). *Id.*, Philippi, Conch. Cab., 1852, p. 126, pl. 18, fig. 7. *Id.*, Reeve, Conch. Icon. ix, 1855, pl. xviii, fig. 80. *Id.*, Melvill & Standen, Journ. Linn. Soc., Zool., xxvii, 1899, p. 172. *Id.*, Schepman, Siboga Prosobranchia, xlix, 1909, p. 216.

Neverita flemingiana Tapparone Canefri, Moll. "Magenta," 1873, p. 137.

Mamma flemingiana Brazier, Proc. Linn. Soc. N.S. Wales, i, 1877, p. 239.

Polinices flemingiana Hedley, Proc. Linn. Soc. N.S.W., xxxii, 1907, p. 483.

"Bussor," Jukes Voy. "Fly," ii, 1847, p. 285.

Hab.—Queensland:—Darnley Island (Brazier); Murray Island, Boydong Cays (Haddon); Mast Head Island, Dunk Island, Green Island, Hope Islands, Piper Island (Hedley).

UBER JUKESII *Reeve.*

Natica candidissima Recluz, Journ. de Conch., ii, 1851, p. 87, pl. 2, fig. 3. (*Fide* Reeve, not *N. candidissima* Le Guillou, Revue Zoologique, v, 1842, p. 105.) *Id.*, Petit, Journ. de Conch., v, 1856, p. 36.

Natica jukesii Reeve, Conch. Icon., ix, 1855, pl. xix, fig. 84. *Id.*, Brazier, Proc. Linn. Soc. N.S.W., ix, 1884, p. 797. *Id.*, Sowerby, Thes. Conch., v, 1883, p. 88, pl. 458, fig. 55.

Petit considered that the *N. candidissima* of Recluz, though reported from Brazil, was the same as the Tongan *N. candidissima* of Dr. Le Guillou, and that Reeve's name was therefore superfluous.

I have not collected this species, but I noted in the British Museum that *N. jukesii* was doubtfully distinct from *N. flemingiana*, being a little broader in proportion to height than that species.

Hab.—North Australia (Jukes), Western Australia:—Cossack (Brazier).

UBER LABYRINTHEUM *sp. nov.*

(Plate xxii, fig. 6.)

Mamma deiodosa Brazier, Proc. Linn. Soc. N.S.W., i, 1877, p. 239 (not *Natica deiodosa* Reeve, Conch. Icon., ix, 1855, pl. 9, fig. 35).

Shell ovate-globose, very solid, glossy. Whorls six, rather rapidly increasing, the last descending more than the others. Under the lens, fine close radial hair lines are seen to traverse the whole surface.

Colour uniform cream, except the spire, the umbilicus, and the lip-callus which are all white. Aperture oblique, semi-lunate, rather small. The upper angle of the aperture is filled with a mass of callus which projects as a boss beyond the plane of the lip. This callus arches over the upper part of the umbilicus, spreads across the head of the funicle, which it broadly overlaps, and runs into the pillar lip above the umbilical groove. The umbilicus is deep, narrow and spiral; a broad low funicle which partly chokes it is followed on the outside by a deep furrow.

Length 35 mm., major diameter 32 mm., minor diameter 19 mm.

Hab.—Queensland:—Murray Island (type, self), Darnley Island (Brazier).

Viewed dorsally this species is indistinguishable from *Uber mellosum*. In front it resembles *U. flemingianum*, from which it is separable by the yellow colour and by the wider perforation. An example from New Caledonia, supplied by M. Geret, differs from the Torres Strait shells by a shallow perforation.

UBER MAMMATUM *Bolten.*

(Plate xxii, fig. 1.)

Nerita melanostoma var. *gamma* Gmelin, Syst. Nat. xiii, 1791, p. 3674.

Albula mammata Bolten, Mus. Bolt. (2), 1798, p. 21 for *Mamma mulieris indicæ* Chemnitz, Conch. Cab., v, 1781, p. 284, pl. 189, figs. 1936-1937.

Mammilla fasciata Schumacher, Essai, 1817, p. 190.

Natica fibrosa Eydoux & Souleyet, Zool. "Bonite," ii, 1852, p. 581, pl. 35, figs. 8-11.

Natica filosa Reeve, Conch. Icon. ix, 1855, pl. xvii, figs. 72 a, b (not *Natica filosa* Philippi, Abbild. Beschr. ii, 1845, p. 42, pl. ii, fig. 4). *Id.*, Angas, Proc. Zool. Soc., 1877, p. 182. *Id.*, Sowerby Thes. Conch., v, 1883, p. 98, pl. 457, fig. 74. *Id.*, Hidalgo, Cat. Moll. Filip., 1905, p. 159. *Id.*, Schepman, Siboga Prosobranchia, 1909, p. 217. *Id.*, Odhner, Kungl. Sv. Vet. Akad., Handl., lii, 1917, p. 10.

Ruma filosa Brazier, Proc. Linn. Soc. N.S.W., i, 1877, p. 238.

Hab.—Queensland:—Darnley Island, Cape Grenville 15 fathoms, Low Island, Trinity Bay, (Brazier); Caloundra (Kesteven); Dunk Island (Banfield); Palm Islands, Annam River, Mapoon 10 fathoms, Mornington Island (Hedley). New South Wales:—Farm Cove 5 fathoms, Port Stephens (Angas). Western Australia:—Broome (Mjöberg).

UBER MELANOSTOMOIDES *Quoy & Gaimard.*

Natica melanostomoide Quoy & Gaimard, Zool. Astrolabe, ii, 1833, p. 229, pl. 66, figs. 4-8.

Natica melanostomoides Deshayes, An. s. vert., (2), viii. 1838, p. 652. *Id.*, Philippi, Conch. Cab., 1852, p. 58, pl. 9, fig. 5. *Id.*, Reeve, Conch. Icon., ix, 1855, pl. xxii, fig. 101. *Id.*, Brazier, Journ. of Conch., ii, 1879, p. 190. *Id.*, Troschel, Gebiss der Schnecken, i, 1863, p. 183. *Id.*, Schepman, Siboga Prosobranchiata, xlix, 1909, p. 216.

Ruma melanostomoides Brazier, Proc. Linn. Soc. N.S. Wales, i, 1877, p. 238.

Hab.—Queensland:—Cape Grenville 30 fathoms, Fitzroy Island (Brazier), Attagoy, Torres Strait (Jukes in Brit. Museum), Murray Island (Hedley).

UBER MELLOSUM *sp. nov.*

(Plate xxii, fig. 5.)

Shell massive, helicoid, very glossy. Colour cream, except the earlier whorls, the basal margin, and the callus, which are pure white. Whorls five, slowly increasing, the last half whorl descending from the plane of the rest. Spire small, acute. Aperture oblique, semilunate, about a third of the total breadth. Callus very large and thick; a rounded lobe fills the whole umbilical area, reaching as far as the opercular nucleus and a prominent boss fills the upper angle of the aperture.

Length 43 mm., major diameter 40 mm., minor diameter 22 mm.

Hab.—Queensland:—Eagle Island (type), Hope Island, Murray Island 5-8 fathoms (self), Home Island, Darnley Island (Brazier).

Apparently this is the species figured by Philippi[1], and is certainly that recorded by Brazier[2] from Queensland as *Mamma straminea* Recluz. Consulting Recluz[3] for the introduction of this name, it is found that both *Natica straminea* and *N. sulphurea* are based on the yellow variety of *U. mammilla* that is mentioned by Linné[4], so this name must be eliminated from its ordinary usage.

Authors generally have failed to distinguish the cream shell from the orange one. Material before me suggests that *aurantium* and *mellosum* are geminate species, the former ranging westwards, the latter extending from the Moluccas, through Torres Strait to New Caledonia and the Solomon Islands. Because each varies in size and shape, the differential characters are hard to grasp, but besides the

1 Philippi—Conch. Cab., 1852, pl. 16, fig. 3.
2 Brazier—Proc. Linn. Soc. N.S.W., i, 1877, p. 239.
3 Recluz—Proc. Zool. Soc., 1843, p. 211.
4 Linné—Museum Ludoviciæ Ulricæ Reginæ, 1764, p. 675.

distinction of colour, *U. mellosum* has the aperture proportionally narrower, the last whorl descending faster, and the callus knob more prominent than in *U. aurantium* Bolten, as expressed by Chemnitz[5].

Probably it is this species which under the name of *Natica aurantia* Lamarck was noted from Torres Strait and Port Essington by Melvill and Standen[6] and by Watson[7].

Uber nuxcastaneum *Martyn*.

Nerita nuxcastanea Martyn, Univ. Conch., iii, 1786, pl. 106.

Natica maura Lamarck Encycl. Meth., 1816, explan. pl. 453, fig. 4. *Id.*, Sowerby, Tank. Cat., 1825, p. 47. *Id.*, Recluz, Proc. Zool. Soc., 1843, p. 214. *Id.*, Philippi, Conch. Cab., 1852, p. 58, pl. 9, fig. 6. *Id.*, Reeve, Conch. Icon., ix, 1855, pl. vii, fig. 25. *Id.*, Chenu, Manuel, i, 1859, p. 214, fig. 1173. *Id.*, Sowerby, Thes. Conch., v, 1883, p. 98, pl. 456, fig. 36. *Id.*, Hidalgo, Cat. Moll. Test. Filip., 1905, p. 160. *Id.*, Schepman, Siboga Prosobranchia, xliii, 1909, p. 217.

Ruma maura Brazier, Proc. Linn. Soc. N.S. Wales, i, 1877, p. 238.

Polinices maura Shirley, Proc. Roy. Soc. Queensland, xxiii, 1911, p. 98.

Polinices nuxcastanea Hedley, Proc. Linn. Soc. N.S. Wales, xxxviii, 1913, p. 301.

Hab.—Queensland:—Darnley Island (Jukes & Brazier), Murray Island (Shirley). Perhaps the type was obtained by the naturalists of the "Endeavour" near Cooktown.

Uber opacum *Recluz*.

(Plate xxii, fig. 3.)

Natica opaca Recluz, Journ. de Conch., ii, 1851, p. 199.

Natica melanostoma Reeve, Conch. Icon., ix, 1855, pl. viii, sp. 30 a, b (not *Nerita melanostoma* Gmelin, Syst. Nat., xiii, 1791, p. 3674).

Neverita melanostoma Tapparone-Canefri, Moll. "Magenta," 1873, p. 136.

Ruma melanostoma Brazier, Proc. Linn. Soc. N.S.W., i, 1877, p. 238.

Natica melanochila Philippi, Conch. Cab., 1852, p. 56, pl. 9, fig. 3.

This species seems to have been usually confused with *U. melanostoma*. The glossy surface and deep furrow, bounding the funicle, which ascends the umbilicus, serve as useful recognition marks. The specimen figured is 45 mm. long, I took it, 17/6/'23, alive on the sandy beach of Chapman Island, North Queensland.

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5 Chemnitz—Conch. Cab., v, t. 189, figs. 1934 5.
6 Melvill & Standen—Journ. Linn. Soc. Zool., xxvii, 1899, p. 172.
7 Watson—Zool. Rep. Chall., xv, 1886, p. 451.

Hab.—Queensland:—Murray Island, Palm Island, Green Island, and Chapman Island (Hedley). It is also in the Museum collection from Lord Howe Island (Bell), Buka, Solomons (Capt. Burrows) and New Caledonia.

UBER PES-ELEPHANTIS *Deshayes.*

Natica alba Gray, in King's Survey, ii, 1827, p. 482 (not *Uber album* Humphrey, Mus. Calonn., 1797, p. 21, nor *Natica alba*, Potiez and Michaud, Gal. Douai, i, 1838, p. 289, nor *Natica alba* Loven, Zool. Soc. Cuv., 1843, p. 118).

Mamillaria lactea Swainson, Treat. Malac., 1840, p. 345 (not *Natica lactea* Guilding, Trans. Linn. Soc. v, 1831, p. 9).

Natica pes-elephantis Deshayes, Anim. s. vert., (2), viii, 1838, p. 650. All based on Chemnitz Conch. Cab., v, 1781, p. 275, pl. 189, figs. 1922-23.

Mamma pes-elephantis Schmeltz, Cat. v, Museum Godeff., 1874, p. 107 (not *Natica pes-elephantis* Pfeiffer, Wiegm. Arch. Naturg., 1840, p. 254).

I have not seen an Australian specimen of this shell.

Hab.—Queensland:—Port Denison (Godeffroy Museum).

UBER POWISIANUM *Recluz.*

Natica powisiana Recluz, Proc. Zool. Soc., 1843, p. 210 (June, 1844). *Id.*, Philippi, Conch. Cab., 1852, p. 46, pl. 7, fig. 4. *Id.*, Reeve, Conch. Icon., ix. 1855, pl. vi, fig. 22.

Natica cumingiana Smith, Zool. Coll. "Alert," 1884, p. 58 (not *N. cumingiana* Recluz, Proc. Zool. Soc., 1843, p. 210).

The name of *Natica cumingiana* has a complicated history due to exchange of Cumingian shells. In 1844 Recluz fully described *Natica cumingiana*, a uniform golden yellow shell, 46 mm. long, from the Island of Cayo in the Philippines. In 1845 Philippi figured a dissimilar shell under this name, but recognising the error he figured in 1852 a shell which better agreed with the original description. In 1855 Reeve figured for *cumingiana* a shell which he said was *N. pallium* Recluz, and which may be *N. gruneriana*, but cannot be *cumingiana* Recluz. In 1884 E. A. Smith ranked *N. powisiana* and *N. draparnaudi* as varieties of *N. cumingiana*, and next year Cooke reduced *N. cumingiana* to a synonym of *N. rufa* Lk. which is clearly wrong. In conclusion, what Reeve figured is unlike what Recluz described as *N. cumingiana*. But what Reeve illustrated as *N. draparnaudi*, may not be that species but may be the real *N. cumingiana* of Recluz.

Hab.—Queensland:—Port Molle ("Alert"), Caloundra (Prof. T. H. Johnston).

UBER PYRIFORME *Recluz.*

(Plate xxii, fig. 4.)

Natica pyriformis Recluz, Proc. Zool. Soc., 1843, p. 211 (June, 1844). *Id.*, Philippi, Conch. Cab., 1852, p. 60, pl. 9, fig. 8. *Id.*, Reeve, Conch. Icon., ix, 1855, pl. v, fig. 16.

Mamma pyriformis Brazier, Proc. Linn. Soc. N.S.W., i, 1877, p. 239.

Natica cygnea Philippi, Conch. Cab., 1852, p. 80, pl. xii, fig. 6.

Natica vestalis Philippi, Conch. Cab., 1852, p. 126, pl. xviii, fig. 6. *Id.*, Proc. Zool. Soc., 1851, p. 234 (June 29, 1853).

Natica mamilla Reeve, Conch. Icon., ix, 1855, pl. vii, fig. 27 a, b. *Id.*, Watson, Report Chall. Zool., xv, 1886, p. 452 (not *Nerita mammilla* Linn., Syst. Nat., x, 1758, p. 776).

The original presentation by Linné in 1758 of *Nerita mammilla* covered different though allied species from both the East and West Indies. Of these most authors have chosen the Oriental shell of Rumphius to carry the name. But the Linnean shell should be interpreted as *N. lactea* Guilding, or a related form, because four out of five citations belong to the West Indian form, which besides is described as from "Barbados" and as "*umbilicata.*" The space left vacant in the East by the transfer to the proper subject of the name *N. mammilla*, is filled by *N. pyriformis.*

As remarked in the "Challenger" report, a useful recognition mark of this species is the small brown dot of the initial whorl. The specimen now figured is 52 mm. in length and was collected by myself at Goold Island.

Hab.—Western Australia:—Swan River 10 fathoms (type, Collie); Queensland:—Darnley, Warrior, Eclipse and Home Islands (Brazier), Albany Island 7-12 fathoms ("Challenger"), Goold, Palm, Lizard and Hope Islands (Hedley).

UBER SEBÆ *Recluz.*

(Plate xxii, fig. 7.)

Helix mamillaris Born, Test. Mus. Cæs. Vind., 1780, p. 380, pl. xv, figs. 13-14. *Id.*, *Brauer*, Sitz. k. Akad. Wiss, lxxvii, 1878, p. 66.

Ruma mamillaris H. & A. Adams, Genera Rec. Moll, 1855, pl. xxii, fig. 5 (not *Helix mammillaris* Linn. Syst. Nat., xii, 1767, p. 1246).

Natica sebæ Recluz, Proc. Zool. Soc., 1843, p. 214 (June, 1844). *Id.*, Souleyet, Zool. Bonite, ii, 1852, p. 579, pl. 35, figs. 6-7. *Id.*, Philippi, Conch. Cab., 1852, p. 123, pl. 18, fig. 1. *Id.*, Hidalgo, Cat. Moll. Test. Filip., 1905, p. 161. *Id.*, Gray, List Moll. Brit. Mus., 1855, p. 22 (not *N. Sebæ* Reeve, Conch. Icon., ix, 1855, pl. xvii, fig. 74, nor Sowerby, Thes. Conch., v, 1883, pl. 457, fig. 79).

Natica melanostoma Hedley, Mem. Austr. Mus., iii, 1899, p. 416 (not *N. melanostoma* Gmelin, 1791).

These references will convey how generally this species has been misunderstood. The shell here figured is 38 mm. long and was collected by myself at the entrance of the Annam River, North Queensland.

Hab.—Queensland:—Annam River, Dunk, Mornington and Forsyth Islands (Hedley); Caloundra (Iredale). Western Australia: —Shark Bay (A. U. Henn). Ellice Group; Funafuti (Hedley).

Uber simiæ *Deshayes.*

(Plate xxii, fig. 2.)

Natica sigaretina ? Menke, Synops. Meth. Moll., 1830, p. 47 (not *Natica sigaretina* Deshayes, Descrip. coq. foss. Paris, ii, 1824, p. 170, pl. 21, figs. 5, 6).

Natica simiæ Deshayes, Anim. s. vert., (2), viii, 1838, p. 652 for *Rumα simiæ* Chemnitz, Conch. Cab., v. 1781, p. 285, pl. 189, fig. 1938. *Id.*, Philippi, Conch. Cab., 1852, p. 35, pl. 4, fig. 17. *Id.*, Reeve, Conch. Icon., ix, 1855, pl. xxii, fig. 98 a, b (but not pl. xvii, fig. 76, = *U. simioides*, Recluz). *Id.*, Schepman, Siboga Prosobranchia, xlix, 1909, p. 217. *Id.*, Melvill & Standen, Journ. of Conch., viii, 1895, p. 121.

Polinices simiæ Iredale, Proc. Mal. Soc., ix, 1910, p. 71. *Id.*, Oliver, Trans. N.Z. Inst., xlvii, 1915, p. 524.

Numerous references to this in literature appear to me to relate to other species. The original locality of "New Zealand" quoted by Favanne and Chemnitz is certainly wrong, but probably indicates Cook's voyage as the source of the specimens, so Cooktown may have been the locality of the type. The specimen here figured, 24 mm. in length, comes from that neighbourhood.

Hab.—Queensland:—Hope Islands (specimen figured), Palm Islands, Lizard Island, Murray Island, Rocky Island (Hedley); Caloundra (Iredale), Lord Howe Island (Bell), Norfolk Island (Bell); Kermadec Islands (Iredale), Loyalty Islands (Hadfield).

REPTILES AND BATRACHIANS FROM SOUTH AND SOUTH-WEST AUSTRALIA.

By

J. R. Kinghorn, C.M.Z.S., Zoologist.

During the first half of the year 1920, Mr. E. le G. Troughton, Zoologist in charge of Mammals and Osteology, undertook a collecting trip to South Australia. Starting at Adelaide he visited many localities from Kangaroo Island in the south, through Eyre's Peninsula to Farina in the north. Towards the latter part of the following year, in company with Mr. J. H. Wright, Assistant Taxidermist, he journeyed across the southern part of Australia by way of the Trans-Australian Railway, spending a few days here and there on the Nullarbor Plain at such places as 407 Miles (referred to in the map and text as Immarna, a name since given to the locality), Ooldea, and Fisher.

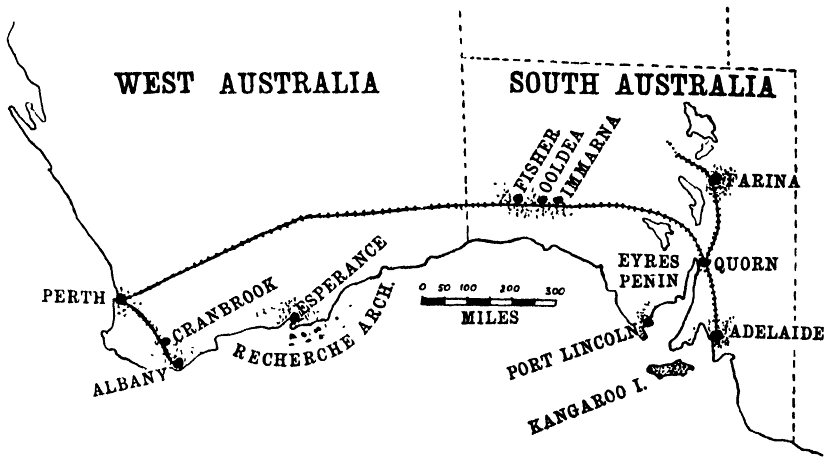


Fig. 1. Map showing collecting areas referred to.

When Mr. Troughton returned to the Museum from Albany, Mr. Wright joined Mr. A. F. Bassett Hull, Honorary Ornithologist, and Mr. H. S. Grant, Taxidermist, who were making preparations for a visit to the Esperance district and Recherche Archipelago, where, at a later date, some very interesting material was collected.

The following list deals with the specimens collected during the three trips.

OPHIDIA.

DEMANSIA PSAMMOPHIS *Schlegel.*

Demansia psammophis Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 322.

One specimen from Fisher, South Australia. Total length, 670 mm.; tail, 140 mm. Scales around centre of body 15; ventrals 195; anal divided; subcaudals, 70 pairs. Collected 23rd October, 1921. Gravid.

One specimen from Immarna, South Australia. Total length, 605 mm.; tail, 113 mm. Scales around body, 15; ventrals, 185; anal divided; subcaudals in 76 pairs.

This species is known as the "Salt Bush Snake" by the residents.

DEMANSIA NUCHALIS *Günther.*

Demansia nuchalis Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 326.

One specimen from Ooldea, South Australia. Total length, 910 mm.; tail, 132 mm. Scales in 17 rows around the centre of the body, ventrals, 199; subcaudals in 55 pairs.

Colour (from life).—Uniform light brown above and creamy white below, with brick-red blotches on the anterior portion of the abdominal surface.

PSEUDECHIS AUSTRALIS *Gray.*

Pseudechis australis Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 330.

One specimen from Immarna, South Australia. Total length, 1030 mm.; tail, 170 mm. Scales in 17 rows around the centre of the body; ventrals, 202; subcaudals, 58, 51 single, the rest in pairs.

Colour (from life).—Sepia brown above, the larger portion of the free edges of the dorsal scales dark sepia brown, the bases almost lemon-yellow. The ventral surface is yellowish white, the free edges of the abdominal scales tinged here and there with brick-red.

One specimen from Fisher, South Australia. Total length, 1130 mm.; tail, 140 mm., tip broken off. Scales in 17 rows around the centre of the body; ventrals, 101; subcaudals, 44 single, the rest paired.

The markings in spirits suggest that they would be the same as the above in life.

Denisonia coronata *Schlegel.*

Denisonia coronata Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 335.

One specimen from Bornham, Western Australia. Total length, 180 mm.; tail, 34 mm. Scale rows, 15; ventrals, 140; anal single; subcaudals, 48.

One from Mississippi Bay, 28 miles east from Esperance, Western Australia. Total length, 270 mm.; tail, 55 mm. Scale rows, 15; ventrals, 138; anal single; subcaudals, 53.

One from Tudor, 27 miles north from Albany, Western Australia. Total length, 320 mm.; tail, 64 mm. Scales in 15 rows; ventrals, 142; anal single; subcaudals, 48.

Denisonia coronoides *Günther.*

Denisonia coronoides Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 336.

Two specimens from Mondrain Island, Recherche Archipelago, Western Australia. (A), Total length, 480 mm.; tail, 85 mm. Scales in 15 rows; ventrals, 159; anal single, subcaudals, 53. (B), Total length, 510 mm.; tail, 90 mm. Scales in 15 rows; ventrals, 146; anal single; subcaudals, 48.

These insular specimens are similar to the mainland form in colour and markings.

Denisonia gouldii *Gray.*

Denisonia gouldii Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 342.

One specimen from Ooldea, South Australia. Total length, 240 mm.; tail, 26 mm. Scales in 15 rows; ventrals, 159; subcaudals, 32; anal single. Typical form.

Notechis scutatus *Peters.*

Notechis scutatus, Boulenger, Brit. Mus. Cat. Snakes, iii, 1896, p. 351.

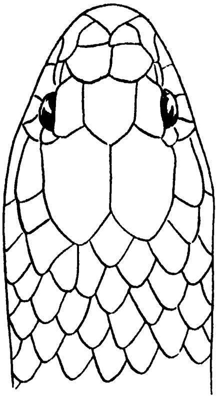
One specimen from Gibbon's Soak, 12 miles north of Esperance, Western Australia. Total length, 780 mm. Scales in 17 rows. One from Tudor, 27 miles from Albany, Western Australia. Total length, 1000 mm. Scales in 19 rows. The colour markings and specific characters of these two specimens are typical.

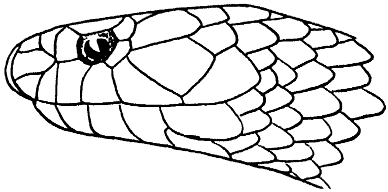
Notechis scutatus *Peters* var. niger *Kinghorn.*

Notechis scutatus var. *niger* Kinghorn, Rec. Austr. Mus., xiii, 4, 1921, p. 145, pl. xxvi, figs. 6-8.

One specimen from Deep Creek, 20 miles from Kingscote, Kangaroo Island, South Australia. Total length, 1430 mm.; tail, 162 mm. Scales in 19 rows; ventrals, 184, anal entire; subcaudals, 45.

In colour this variety closely resembles *Notechis ater* Krefft, but its scaling and lateral head shields at once distinguish it; moreover it has six upper labials, the third and fourth entering the eye; and the chin shields are equal in length.





Figs. 2-3. *Notechis scutatus* Peters, var. *niger* Kinghorn.

Fig. 2. Dorsal view. Fig. 3. Lateral view.

Colour.—The general colour is black above and bluish grey on the abdominal surface, while the chin shields and surrounding scales are whitish.

The inhabitants of Kangaroo Island refer to this species as the "Black Snake" evidently confusing it with the Black Snake, *Pseudechis porphyriacus*, of the mainland.

Mr Troughton shot this specimen whilst it was attempting to drag away a rat which was trapped.

LACERTILIA.

NEPHURUS LÆVIS *De Vis.*

Nephurus lævis Boulenger, Brit. Mus. Cat. Lizards iii, 1887, p. 475.

One specimen from Immarna, South Australia, and one from Ooldea, South Australia. The former specimen is 63 mm. in length, and 50 mm. from snout to vent. The fore limb when stretched forwards does not reach to the nostril. There are 19 upper labials and between the orbits are five rows of tubercles. The hind limb when stretched forward reaches to the axilla, and is half as long as the distance from snout to vent. The markings differ slightly from the typical form as described by De Vis.

Colour and markings (in spirits).—Creamy white above with six small dark spots on the fore part of the head as follows:—one on each side under the anterior angle of the orbit, one immediately behind each nostril, one above the rostral, and another almost between the orbits. There is a dark three-pronged mark on the occiput, while a light band crosses the head behind the orbits and connects on each side with a thicker and darker one which zigzags longitudinally to the neck. On the neck is a short transverse bar, behind which are two arcs, the posterior one extending well down over the shoulders, the two thereby enclosing a white crescent. There is a longitudinal, irregular bar over each hip, and a small transverse mark on the sacrum.

Fig. 4. New variety of colour marking in *Nephurus lævis*, De Vis.

The Ooldea specimen is 85 mm. from snout to vent. The fore limb when stretched forward reaches almost to the tip of the snout, while the hind limb does not reach nearly to the axilla, and it is less than half as long as the distance from the snout to the vent. There are 20 upper labials and between the orbits are five rows of tubercles. The colour markings are similar to those given by Lucas and Frost[1] and approach the *N. platurus* form rather than the typical *N. lævis*.

RHYNCHŒDURA ORNATA *Günther*.

Rhynchœdura ornata Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 12, pl. ii, fig. i.

One specimen from Ooldea, South Australia.

Length from snout to vent, 45 mm. The specific characters, colour and markings are typical. Tail missing.

1 Lucas and Frost—Rep. Horn Sci. Exped., ii, (Zoology), 1896, pp. 115-118.

CERAMODACTYLUS DAMÆUS *Lucas and Frost.*

Ceramodactylus damæus Lucas and Frost, Rep. Horn Sci. Exped. pt. ii, (Zoology) 1896, p. 119, pl. ix, fig. 2.

One specimen from Ooldea, South Australia. Total length, 74 mm.; snout to vent, 40 mm.; head, 12 mm.; width of head, 9 mm.; fore limb, 14 mm.; hind limb, 18 mm.; tip of snout to ear, 10 mm.

The colour markings agree, in general, with those given by Lucas and Frost, but there are more white spots on the sides below the dark lateral band on the specimen before me than there are on the type.

GYMNODACTYLUS MILIUSII *Bory.*

Gymnodactylus miliusii Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 48.

Two specimens from Ooldea, South Australia. One from Mount Lyndhurst, 30 miles east of Farina, South Australia; three from Proper Bay, 8 miles from Port Lincoln, Eyre's Peninsula; one from Charley Island, Recherche Archipelago.

The Mount Lyndhurst specimen was caught at night on bare ground under low bushes. All the specimens are typically marked, but the three from Proper Bay have longer and slimmer tails than the others, a fact probably due to them being very young.

HETERONOTA BYNŒI *Gray.*

Heteronota bynœi Gray, Brit. Mus. Cat. Lizards, 1845, p. 174. *Id.*, Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 74. *Id.*, Lucas and Frost, Rep. Horn. Sci. Exped. ii, (Zoology), 1896, pp. 120-122, pl. xi, figs. 1-2.

Eublepharis derbiana Gray, Brit. Mus. Cat. Lizards, 1845, p. 274.

Heteronota derbiana Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 75.

Two specimens from Mount Lyndhurst, 30 miles east of Farina, and one from Ooldea, South Australia.

The colour markings of this species are liable to a fair degree of variation, as also are some of the lesser structural characters. After examining a series of forty-five specimens in the Australian Museum collection I find that I must agree with Lucas and Frost in that it is impossible to separate *H. derbiana* from *H. bynœi.*

The length of the head in comparison to the body is extremely variable, while the arrangement of the dorsal tubercles is generally regular, the variations being too slight to be of any specific or even varietal importance.

I append a revised definition of the species.

Head oviform, moderately depressed, its length equal to, or a little more than, one third the distance from the tip of the snout to the vent. Snout a little longer than the diameter of the orbit. Eye midway between the tip of the snout and the ear opening. Pupil vertical. Forehead concave. Snout covered with large granules which may be more or less strongly keeled. Hinder part of head covered with small granules, among which, numerous enlarged rounded or pyramidal ones are interspersed. Rostral about twice as broad as high, with a median cleft above. Nostril small, pierced between the first labial and three or four nasals. Seven or eight upper and six lower labials. Mental large, broadly pentagonal, behind which the two large chinshields form a suture. Dorsal surface of body covered with small keeled granular scales, and large, subtriangular, strongly keeled tubercles which may be arranged in twelve to fourteen more or less regular longitudinal rows. Abdominal scales large, cycloid, imbricate. Scales under the throat very small. Limbs covered with scales similar to those on the body. Four to eight preanal pores. Tail cylindrical and tapering, verticillate, bearing large keeled scales and tubercles above, and a medium series of transversely enlarged plates below.

Colour.—Greyish to brownish above, with lighter and darker markings forming more or less regular or oblique cross bands. Top of head mottled with reticulate lines or spots. A broad dark streak through each eye may or may not join behind the head. Lower surfaces creamy white, each scale microscopically spotted with black.

Phyllodactylus marmoratus *Gray.*

Phyllodactylus marmoratus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 88, pl. vii, fig. 6.

Phyllodactylus guentheri Boulenger, loc. cit., p. 90, pl. vii, fig. 3.

Thirteen specimens were collected from the following localities:—One from Mount Lyndhurst, 30 miles east of Farina, South Australia, and four eggs from crevices under rocks in the same locality; six from Port Lincoln, Eyre's Peninsula, South Australia; two from Proper Bay, Tulka, 8 miles from Port Lincoln; two from Michaelmas Island, King George Sound, Western Australia, and one each from Grunton Island and Rabbit Island, Recherche Archipelago, Western Australia.

The series ranges from 58 to 105 mm. in length, and the mottled colour of the back varies considerably from irregular formless markings to irregular cross bands resembling shadows thrown by sand ripples on a beach. The markings on the tail may be either longitudinal or transverse. In some of the specimens the tail is not very much swollen, while in others it is quite as broad as the body.

As Zietz[2] placed *Phyllodactylus guentheri* Boulenger in the synonymy of the above, I examined a series of specimens in the Australian Museum collection and finding the variation so great agree that it is impossible to separate the two forms.

Diplodactylus spinigerus *Gray.*

Diplodactylus spinigerus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 99.

One specimen from Esperance, Western Australia. Total length, 110 mm.; snout to vent, 65 mm.; head, 17 mm.; width of head, 13 mm.; fore limb, 24 mm.; hind limb, 30 mm.

This specimen does not show any variation from the typical form.

Peropus variegatus *Dumeril and Bibron.*

Peropus variegatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 151.

Fourteen specimens were collected from the following localities:—Nine from Mount Lyndhurst, 30 miles east of Farina, South Australia; most of these were captured under the dried loose bark on old Casuarina stumps; three eggs containing fairly well developed embryos were collected from the same locality. Four specimens were taken at Immarna, South Australia, and one from Proper Bay, Tulka, 8 miles from Port Lincoln, South Australia.

The series ranges in length from 46 to 95 mm. and the colour markings are very variable. The lines and mottlings on the dorsal surface may be either very strong and definite, or so weak as to be almost indistinguishable from the general ground colour of the back.

Delma fraseri *Gray.*

Delma fraseri Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 243.

One specimen from Immarna, South Australia. Total length 247 mm.; tail, 174 mm., which is equal to about two and one-half times as long as the head and body. The nostril is pierced between the first upper labial, two nasals and a loreal. Distance from snout to eye 3 mm. and from snout to anterior border of ear opening 9 mm.

Rostral triangular; seven upper and six lower labials; scales in sixteen rows around the middle of the body; ventral scales in 49 pairs.

The tail is much shorter than is usual for this species, being intermediate in length between *D. fraseri* and *D. impar.* The genus *Delma* needs complete revision, but a larger series of specimens than that available would be necessary before any definite conclusions regarding the status of the various species could be reached.

[2] Zietz—Rec. S. Austr. Mus., iii, 1920, p. 185.

AMPHIBOLURUS RETICULATUS *Gray.*

Amphibolurus reticulatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 386, pl. xxi, fig. 1.

Two specimens from Mondrain Island, Recherche Archipelago, Western Australia. Total length 193 and 215 mm., head and body 80 mm.

These specimens differ slightly from mainland specimens both in specific characters and colour pattern as given by Boulenger, but the markings agree with those of some of the specimens figured by Werner[3].

The tympanum is a little more than half the diameter of the eye. Some of the larger scales of the back tend to become spine-like; the adpressed hind limb reaches almost to the eye, while the tail is very depressed at the base, and is a little more than once and one half times the length of the head and body.

AMPHIBOLURUS ADELAIDENSIS *Gray.*

Amphibolurus adelaidensis Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 387.

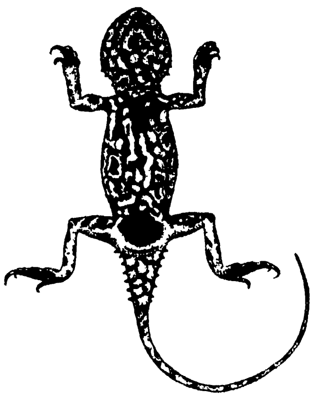


Fig. 5. *Amphibolurus adelaidensis.* Under surface of male.

One (male) from Mississippi Bay, 28 miles east of Esperance, Western Australia, and one (female) from Pink Lake, 4½ miles from Esperance.

The structural characters of both agree perfectly with the typical form, likewise the colour markings of the female, but the entire under surface of the male is covered with very conspicuous black markings.

3 Werner—Fauna Südwest Australiens, ii, 1909, p. 271, pl. xiv, figs. 1-7.

AMPHIBOLURUS BARBATUS *Cuvier.*

Amphibolurus barbatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 391.

Six specimens from Immarna, South Australia.

The series consists of males and females, some of the latter bearing well developed eggs. All agree with the typical description with the exception that the head scales may be very strongly keeled, or the keels may be so obtuse as to be invisible to the naked eye.

One specimen from Proper Bay, Tulka, Eyre's Peninsula, South Australia. Total length, 172 mm.; head and body, 60 mm.

One from Port Lincoln, South Australia. Total length, 117 mm.; head and body, 37 mm.

Both these specimens agree with the typical form in every respect.

AMPHIBOLURUS MACULATUS *Gray.*

Amphibolurus maculatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 381.

A fine series of ten specimens from Immarna, South Australia, shows that the colour markings are very variable, and those before me might be considered as modifications of markings described from the specimens collected by the Horn Expedition.

In the smaller specimens the light bands stretching from the sides of the nape and extending along the sides of the body and tail are conspicuous, but in two of the larger ones they are broken and inconspicuous, while in another, in which they do not extend beyond the neck, the dorsal surface is spotted with light and dark irregular markings.

In two specimens the fore parts of the legs and feet are black, and in one of these the black area of the under surface (described and figured by Lucas and Frost[4]) forms a long point which stretches down the abdomen and joins the apex of the angle formed by the preanal pores.

The series ranges in length from 105 to 180 mm., while the measurements of the head and body range from 46 to 57 mm.

The angle formed by the preanal pores may be sharp or obtuse.

[4] Lucas and Frost—*loc. cit.*, p. 125, pl. ix, figs. 4-5.

AMPHIBOLURUS CRISTATUS *Gray.*

Amphibolurus cristatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 383, pl. xxix, fig. 1.

A series of five specimens ranging in length from 150 to 355 mm. Four are from Immarna and one from Ooldea, South Australia.

The ventral scales are feebly though quite definitely keeled. Irregular, reticulated dark markings cover the dorsal and lateral surface of the head and may or may not extend as far as the sacral region. The most conspicuous marks, except those on the head, are two series of broad dark blotches, one on each side, from the nape almost to the thigh. There are well marked reticulations on the upper surface of the arms and legs while many of the larger scales of the lateral and dorsal surface are whitish.

AMPHIBOLURUS ORNATUS *Gray.*

Amphibolurus ornatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 385.

Eight specimens from Proper Bay, Tulka, 8 miles from Port Lincoln, South Australia.

General colour (in spirits).—Head brown, body dark grey to olive-brown above, with lighter and darker marblings, reticulations and spots.

In four adult specimens, measuring from 190 to 200 mm. in length, the sides of the neck bear white ocellations, while the tufts of small spines behind the nape are also white. The tail may bear more or less distinct dark cross bars or light and dark ocellations on the dorsal surface. The limbs are marked similarly to the body. The under surface is yellowish white, and there are dark reticulations beneath the chin and throat, while large dark areas cover the chest and under surface of the limbs.

In the fifth adult, measuring 170 mm. in length, there are no white ocellations and no white tufts on the head parts. The abdominal surface is yellowish white, but reticulations are present under the throat.

There are three young specimens measuring from 80 to 112 mm. in length; the smallest bears very small, but conspicuous, white dots on the dorsal surface, while the intermediate one bears irregular dark ones. The largest of these specimens is marked much the same as the adults but the ocellations on the back are smaller, though much more conspicuous.

The hind limb of every specimen in the series, when stretched forward, reaches to the eye, but in all other structural characters the series agrees with the typical form.

TYMPANOCRYPTUS LINEATUS *Peters.*

Tympanocryptus lineatus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 392.

Two specimens from Ooldea, and one from Fisher, South Australia.

The ground colour of the skin in these desert forms has a distinct tinge of brick red, but the dorsal markings are typical.

In one specimen the dark wavy lines under the throat extend on to the chest. The specimens measure 142 and 164 mm. respectively.

DIPOROPHORA AUSTRALIS *Steindachner.*

Diporophora australis Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 394.

Three specimens from Immarna, South Australia.

This species has always been regarded as a northern one, and therefore the specimens before me may be regarded as new records for this part of Australia.

The only other species of the genus known from this area are, *D. bilineata* and *D. winneckei*[5]; but *D. australis* differs from the former in having a strong gular fold, and from the latter in having a shorter and stouter body, and by the presence of preanal pores.

The measurements of the Immarna specimens are as follows:—Total length 123 mm., 165, 170; head and body 38 mm., 49, 49; tail 83 mm., 117, 121.

In all the specimens a strong gular fold is present. The hind limb when stretched forward reaches the orbit. The tail is a little more than twice as long as the head and body.

Colour (in spirits).—Brownish above with a few dark mottlings, and two very distinct light coloured lines extending from the nape on to the tail. The under surface is whitish with a few indistinct spots under the lower labials, in front of the gular fold, and round about the ventral areas.

MOLOCH HORRIDUS *Gray.*

Moloch horridus Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 411.

One specimen from Immarna, South Australia. Total length 142 mm. Head and body 77 mm.

This specimen agrees perfectly with previously published descriptions, but one of three presented by Mr. A. S. Le Souef from the same locality is remarkable for the fact that the globular knob on the neck is covered with very small granular, spiny scales, the large lateral spines being absent.

[5] Lucas and Frost—*loc. cit.*, p. 132, pl. xi, fig. 5.

VARANUS VARIUS *Shaw.*

Varanus varius Boulenger, Brit. Mus. Cat. Lizards, ii, 1885, p. 319.

Two specimens were collected; one from Cranbrook, south Western Australia, and one from Birchmore Lagoon, 15 miles from Kingscote, Kangaroo Island, South Australia.

The latter is somewhat darker, and the light cross bands less distinctly marked than is usual with the mainland forms.

VARANUS GOULDII *Gray.*

Varanus gouldii Boulenger, Brit. Mus. Cat. Lizards, ii, 1885, p. 320.

Four specimens were collected; one each from Mount Lyndhurst, 20 miles east of Farina, and Fisher; and two from Immarna, South Australia.

The Fisher specimen is typically marked, but in the other three the reticulations and ocelli on the dorsal and lateral surfaces vary in density; it is only here and there that they are distinguishable from the dark transverse bands so that together they form a rather irregular pattern. The markings on the top, sides of the head, and on the tail, and the spots on the abdominal surface, do not vary from those of the typical form.

VARANUS EREMIUS *Lucas and Frost.*

Varanus eremius Lucas and Frost, Rep. Horn Sci. Exped., ii, (Zoology), 1896, p. 135, pl. vii, fig. 1.

One specimen from Immarna, South Australia. Total length 315 mm.; tip of snout to gular fold 38 mm.; gular fold to vent 73 mm.; tail 195 mm.

Found running on debris under spinifex ("porcupine") grass. The specimen agrees in all respects with the original description.

EGERNIA KINGII *Gray.*

Egernia kingii Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 138.

One from Mississippi Bay, 28 miles east of Esperance, Western Australia; two from Charley Island and one from Woody Island, Recherche Archipelago; one from Lucky Bay, 26 miles east of Esperance, Western Australia.

There is no variation between the mainland and the Recherche specimens, and the total length ranges from 200 to 240 mm.

EGERNIA WHITEI *Lacépède.*

Egernia whitei Boulenger, Brit. Mus. Cat. Lizards, ii, 1887, p. 135.

Two specimens from Deep Creek, 20 miles from Kingscote, Kangaroo Island, South Australia. One specimen is typically marked with bands and spots, while the other is almost uniformly light brown with only a faint suggestion of darker longitudinal lines.

Two typical specimens from Birchmore Lagoon, 15 miles from Kingscote, Kangaroo Island. Found under loose bark of "yacca" or grass tree.

TILIQUA OCCIPITALIS *Peters.*

Tiliqua occipitalis Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 147.

Two specimens from Ooldea, South Australia, one of which was dug out of a burrow. The respective measurements are:—total length, 380 mm., 400.; head, 60 mm., 62; tail, 129 mm., 125; fore limb, 55 mm., 53; axilla to groin, each 150 mm.

It will be noted that the fore limb is shorter than the head, as mentioned by Lucas and Frost[6], and not longer as mentioned in the British Museum catalogue. The prefrontals form a suture on the median line thus separating the frontal from the frontonasal. One specimen has four ear lobes and the other three. There are four dark bands across the body and three on the tail. Tip of tail black. In all other respects they agree with the typical form. Two specimens from Esperance, Western Australia, agree with those from Ooldea. The respective measurements are:—Total length, 390 mm., 370; head, 63 mm., 62; tail, 120 mm., 110 (broken); fore limb, 55 mm., 53; axilla to groin 145 mm., 150.

TRACHYSAURUS RUGOSUS *Gray.*

Trachysaurus rugosus Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 143.

The collection includes four specimens from Fisher, South Australia, two from Cranbrook, Western Australia, and two from Albany, Western Australia.

The structural characters and markings are typical while the measurements range from 215 to 360 mm. in total length. In the specimens from Fisher the scales of the head are more nodular, and those of the back rougher than in those from Western Australia.

The colour of the Western Australian specimens and the smallest (215 mm.) specimen from Fisher is brownish olive, while the three large specimens from Fisher are brick red.

[6] Lucas and Frost—*loc. cit.*, p. 140.

LYGOSOMA (HINULIA) QUOYI *Dumeril and Bibron.*

Lygosoma (Hinulia) quoyi Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 230.

One typical specimen from Sturt Creek, Blackwood, Adelaide, South Australia. Total length, 260 mm.; tail 160 mm. The specimen was found hiding, submerged to its head in the creek.

LYGOSOMA (HINULIA) LESUEURII *Dumeril and Bibron.*

Lygosoma (Hinulia) lesueurii Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 225.

Two typical specimens; one from Mount Lyndhurst, 30 miles east of Farina, South Australia, total length, 140 mm., tail 85 mm.; and one from Ooldea, South Australia, total length 170 mm., tail 100 mm.

LYGOSOMA (HINULIA) LABILLARDIERI *Gray.*

Lygosoma (Hinulia) labillardieri Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 229.

One from Charley Island, Recherche Archipelago, Western Australia. This specimen has the tip of the tail missing but the structural characters are typical.

A specimen which appears to be this species was taken from the stomach of a snake, *Denisonia coronoides*, collected on Mondrain Island, Recherche Archipelago, Western Australia.

LYGOSOMA (HINULIA) MONOTREPIS *Boulenger.*

Lygosoma (Hiulia) monotrepis Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 237, pl. xiv, fig. 2.

One specimen was collected at Mount Lyndhurst, 30 miles east of Farina, South Australia. Total length 178 mm.; tail 98 mm. 30 scales around the body. One specimen from Ooldea, South Australia. Total length 152 mm.; tail 85 mm.; 30 scales around body.

LYGOSOMA (LIOLEPISMA) TRILINEATUM *Gray.*

Lygosoma (Hinulia) trilineatum Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 279, pl. xxi, fig. 2.

One from Deep Creek, Kangaroo Island, South Australia. This is a very dark variety and the vertebral streak is almost black, while the dark lateral streak is edged with yellowish white. Total length 150 mm.: tail 88 mm.; snout to vent 62 mm.

A specimen from Tudor, Western Australia, measures 48 mm. from snout to vent; the tail is missing.

Colour.—Uniform brown above with an indistinct darker lateral streak edged with lighter.

LYGOSOMA (LIOLEPISMA) GUICHENOTI *Dumeril and Bibron.*

Lygosoma (Liolepisma) guichenoti Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 281.

Five specimens were collected from the following localities within Kangaroo Island, South Australia. Three from Birchmore Lagoon, 15 miles from Kingscote; one from Deep Creek; and one from Timber Creek.

The series ranges from 68 to 115 mm. in length.

LYGOSOMA (HEMIERGIS) PERONII *Fitzinger.*

Lygosoma (Hemiergis) peronii Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 326.

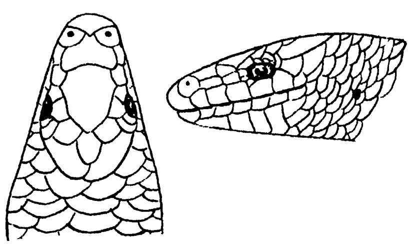
Two from Proper Bay, Tulka, 8 miles from Port Lincoln, South Australia. Total length, 125 and 130 mm.; tail 70 and 78 mm. Found under loose stones. One from Esperance, Western Australia. Total length, 150 mm.; tail, 97 mm.; 20 scales around the body. Pale golden brown above, the dark dorsal and dorso-lateral lines faintly marked. Other marks typical.

One from Woody Island, Recherche Archipelago, Western Australia. Total length, 84 mm.; tail, 30 mm.; (reproduced); snout to vent, 54 mm. This insular specimen shows the same structural characters as the mainland form, but the colour markings are heavier, especially the dorsal and dorso-lateral lines.

One from Birchmore Lagoon, Kangaroo Island, South Australia, has a total length of 113 mm., tail 60 mm.; and there are twenty scales around the body. The dorso-lateral colour line is absent, the specimen being golden brown above and lighter below with typical markings on the under surface of the tail, but the markings on the abdomen are very faint. This specimen is shorter and more thickly set than is usual, but its specific characters do not vary in the least from the typical form.

LYGOSOMA (RHODONA) PLANIVENTRALIS *Lucas and Frost.*

Lygosoma (Rhodona) planiventralis Lucas and Frost, Proc. Roy. Soc., Victoria (n.s.), xv, 1902, p. 78.



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Figs. 6-8. *Lygosoma (Rhodona) planiventralis,* Lucas and Frost.

Fig. 6. Dorsal view. Fig. 7. Lateral view. Fig. 8. Ventral view.

One specimen from Ooldea, South Australia. Total length, 135 mm.; body, 74 mm.; tail, 61 mm.; fore limb, 14 mm.; length of head, 9 mm.; width of head, 5.5 mm. 20 longitudinal rows of scales around the body. The frontonasal forms only a short suture with the rostral.

Colour.—Greyish brown above with two dark dorsal lines formed by regular series of dots. One broad well defined dorso-lateral line on each side. Tail thickly spotted above with more or less continuous lines of brown dots. Dorsal surface of limbs dark spotted.

LYGOSOMA (RHODONA) BIPES *Fischer.*

Lygosoma (Rhodona) bipes Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 337.

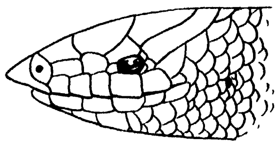


Fig. 9. *Lygosoma (Rhodona) bipes* Fischer. Lateral view.

One specimen from Ooldea, South Australia. One very small preocular scale; two post oculars; two supraoculars, the anterior one being large and triangular. The nasals do not form a suture behind the rostral. There are two loreals between the nasal and the preocular. Five upper labials, the fourth entering the orbit. There are twenty rows of smooth scales round the body.

Colour (in spirits).—Creamy above and below. Head irregularly spotted with brown. A broad brown band starting from the rostral extends along each side of the body on to the tail. Two longitudinal lines of brown spots extend along the dorsal line on to the tail, towards the end of which they, as well as the lateral lines, break up into a suffused mass.

In the Australian Museum reference collection there are two more specimens of this species which should be mentioned here for purposes of comparison. One, from Commonwealth Hill, Central Australia, was presented by Dr. H. Basedow in 1918. It has twenty scales around the body, and the fourth upper labial under the eye. The nasals are not in contact behind the rostral, there are two supraoculars. Tail missing. Length from tip of snout to vent 37 mm.

The second specimen is from Western Australia (no definite locality). This specimen agrees more fully with Fischer's description, but there are two loreals behind the nasal, and a very minute preocular. There are nineteen rows of scales around the body. It is worthy of note that the Central and South Australian specimens before me form

connecting links between Werner's[7] South Western Australian forms, one of which he calls *var. concolor*, and Fischer's[8] holotype which is from Western Australia. Werner also records a specimen from Barrow Range, Central Australia.

LYGOSOMA (RHODONA) PUNCTATOVITTATUM *Günther.*

Lygosoma (Rhodona) punctatovittatum Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 335.

One from Mount Lyndhurst, 30 miles east of Farina, South Australia. Total length, 132 mm.; snout to vent, 70 mm.; tail, 62 mm.

This specimen differs from the typical form by having the fore limb distinctly didactyl. All other structural characters and colour markings agree with previously published descriptions. Examination of a series of specimens in the Australian Museum collection showed that the degree of development in the fore limb was open to variation, and, while no specimens possessed a true didactyl foot, the second toe could be distinguished in some with the aid of a strong lens.

ABLEPHAROUS BOUTONII *Desjard.*

Ablepharous boutonii var. *peronii* Werner, Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 347.

One specimen from Port Lincoln, Eyre's Peninsula, South Australia. Total length, 78 mm.; snout to vent, 34 mm. 26 rows of scales around the body. Median pair of dorsal scales dilated transversely. The hind limb when stretched forward does not reach the axilla. There is a light lateral stripe which is well defined and edged with dark brown. The general colour is olive on the dorsal surface and steel blue on the ventral surface.

VAR. METALLICUS *Boulenger.*

Ablepharous boutonii var. *metallicus* Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 347.

Eight specimens from Mount Lyndhurst, South Australia. The series ranges in length from 37 to 100 mm. and there may be 24 or 26 rows of scales around the body. The median pair of dorsal scales may be more or less strongly dilated transversely. The hind limb does not reach the axilla.

Colour.—Light olive brown or greenish above, strongly metallic, with dark brown spots which may be scattered, or in irregular longitudinal lines. There is a faintly marked irregular band extending from each eye on to the tail.

[7] Werner—*loc. cit.*, 1910, pp. 484-485.
[8] Fischer—Archiv. für Naturg., xlviii, 1, 1882, p. 292, pl. xvi, figs. 10-15.

Ablepharous lineo-ocellatus *Dumeril and Bibron.*

Ablepharous lineo-ocellatus Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 348.

One typical specimen from Bornham, Western Australia.

Var. adelaidensis *Peters.*

Ablepharous lineo-ocellatus var. *adelaidensis* Boulenger, Brit. Mus. Cat. Lizards, iii, 1887, p. 348.

One from Cranbrook, Western Australia. Supranasals present. 20 rows of scales around the body. The dark lateral lines are present, but there are no ocelli on the back.

AMPHIBIA.

Hyla aurea *Lesson.*

Hyla aurea Boulenger, Brit. Mus. Cat. Batr., 1882, p. 410.

One from Tudor, 27 miles from Albany, Western Australia. This specimen bears large longitudinal blotches on the upper surface, while the whole of the under surface is uniform yellowish.

Seven specimens from Albany bear the light dorsal and dorso-lateral lines typical of the species.

Var. cyclorhynchus *Boulenger.*

Hyla aurea var. *cyclorhynchus* Boulenger, Brit. Mus. Cat. Batr., 1882, p. 410.

Colour.—Light above with large, dark, irregular marblings covering the body and legs. The under surface of the body is covered with black reticulations, while the arms, legs, the axilla, and the groin are strongly marbled with black, the enclosed areas forming round white spots.

One from Mondrain Island, Recherche Archipelago, and one from Lucky Bay, near Esperance, Western Australia. In each of these the dorsal surface is marked as above, but the belly is yellowish, the chest and chin only being faintly reticulated, while the hinder side of the thigh is black with small white spots.

Hyla adelaidensis *Gray.*

Hyla adelaidensis Boulenger, Brit. Mus. Cat. Batr., 1887, p. 408.

Two typical specimens from Mississippi Bay, 28 miles E. of Esperance.

HYLA EWINGII *Dumeril and Bibron.*

Hyla ewingii var. *calliscelis* Boulenger, Brit. Mus. Cat. Batr., 1887, p. 406.

Two from Birchmore Lagoon, 15 miles from Kingscote, Kangaroo Island, four from Timber Creek and six from Deep Creek, each 20 miles from Kingscote, Kangaroo Island, South Australia.

HELIOPORUS ALBOPUNCTATUS *Gray.*

Heleioporus albopunctatus Boulenger, Brit. Mus. Cat. Batr., 1887, p. 271.

One specimen 19 mm. in length from Cranbrook, Western Australia.

CRINIA GEORGIANA *Bibron.*

Crinia georgiana var. *affinis* Boulenger, Brit. Mus. Cat. Batr., 1882, p. 265.

One typically marked specimen 27 mm. in length, from Mississippi Bay, 28 miles east of Esperance, Western Australia.

VAR STOLATA *Cope.*

Crinia georgiana var. *stolata* Cope, Boulenger, Brit. Mus. Cat. Batr., 1882, p. 264.

Four specimens from below the forts at Albany, one from Lucky Bay, one from Mississippi Bay, one from Tudor, Western Australia.

This series comprises some beautifully marked specimens, the smallest being 11 mm. and the largest 29 mm. in length. The younger specimens are rather darker on the abdominal surface than are the adults, which may be either immaculate or with a few small dark spots.

CRINIA SIGNIFERA *Girard.*

Crinia signifera Boulenger, Brit. Mus. Cat. Batr., 1882, p. 265.

Fourteen specimens from Birchmore Lagoon, Kangaroo Island, six from Timber Creek, and two from Deep Creek, Kangaroo Island, seven from Port Lincoln, Eyre's Peninsula, one from Mount Lyndhurst, 20 miles east of Farina, South Australia.

Some of the specimens from Kangaroo Island are beautifully marbled and lined; the markings being much stronger on these than on those from the mainland.

Eighteen specimens are from the following localities in Western Australia:—Three from Albany; two very small but beautifully marbled specimens (one typically marked) from Tudor; twelve young, the largest of which is about 7 mm. from Bonham.

PSEUDOPHRYNE BIBRONII *Gray.*

Pseudophryne bibronii Boulenger, Brit. Mus. Cat. Batr., 1882, p. 277.

Two specimens from Deep Creek, Kingscote, Kangaroo Island, South Australia.

LIMNODYNASTES DORSALIS *Gray.*

Limnodynastes dorsalis Boulenger, Brit. Mus. Cat. Batr., 1882, p. 261.

One small specimen 15 mm. in length from Birchmore Lagoon, Kangaroo Island.

VAR. TYPICA *Fry.*

Limnodynastes dorsalis var. *typica Fry,* Rec. Austr. Mus., x, 1913, p. 24, pl. 11, fig. 2.

One from Cranbrook, Western Australia.

VAR. DUMERILI *Fry.*

Limnodynastes dorsalis var. *dumerili* Fry, Rec. Austr. Mus., x, 1913, p. 26, figs. 1 and 1a, pl. iii, figs. 2 and 2a.

One from Birchmore Lagoon, 15 miles from Kingscote, Kangaroo Island.

LIMNODYNASTES TASMANIENSIS *Günther.*

Limnodynastes tasmaniensis Boulenger, Brit. Mus. Cat. Batr., 1882, p. 260.

Fig. 10. *Limnodynastes tasmaniensis* Günther. Colour pattern of Kangaroo Island specimen.

One specimen from Deep Creek, 20 miles from Kingscote, Kangaroo Island. This specimen has a deformed left leg, there being only one toe present. The colouration differs from the typical in that there is no dorsal stripe.

The tarso-metatarsal articulation reaches to the anterior border of the eye.

A SHORT REVIEW OF THE LIZARDS BELONGING TO THE GENUS *LIALIS* GRAY.

By

J. R. Kinghorn, C.M.Z.S., Zoologist.

Genus Lialis *Gray*.

Lialis Gray, Proc. Zool. Soc. London, 1834, p. 134. *Id.*, Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 246. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, 33, 1912, p. 27. *Id.*, Rooij, Reptiles Indo-Australian Archipelago, i, 1915, p. 62.

Alopecosaurus Lidholm, Jahrb. Ver. Nassau, lviii, 1905, p. 231.

Definition.—Body elongate, snake like, rudiments of hind limbs externally. Parietal bone single. Teeth numerous in both jaws, sharply pointed and directed backwards. Tongue flattened, elongate, papillose, nicked at the tip, much broader behind than in front. Ear small, exposed. Head elongate, depressed, covered with small, more or less irregular plates. Scales of body cycloid, imbricate, more or less sharply pointed posteriorly. The median pair of abdominal scales and the central caudals (at least on the anterior part) hexagonal, transversely enlarged. Preanal pores present.

Distribution.—Aru Islands, New Guinea and Australia.

Key to the species of *Lialis*:—

Tip of snout truncate, rostral quite twice as broad as high, 4 preanal pores	*Lialis burtonis.*
Tip of snout sharp pointed, rostral slightly broader than high, 6-8 preanal pores	*Lialis jicari.*

Lialis burtonis *Gray*.

Lialis burtonis Gray, Proc. Zool. Soc., 1835, p. 134. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, 33, 1912, p. 27.

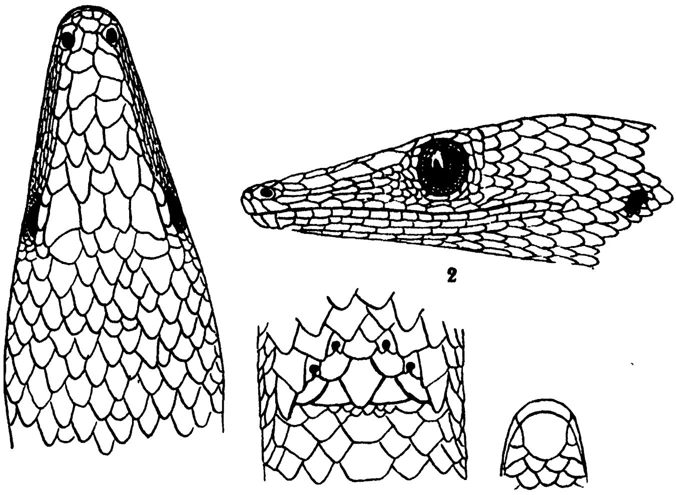
Lialis bicatenata Gray, Zool. Miscell., p. 52; and Zool. "Erebus" and "Terror," Rept., 1845, p. 5.

Lialis punctata Gray, Zool. Miscell., p. 52, and Zool. "Erebus" and "Terror," Rept., 1845, p. 5, pl. viii, fig. 1.

Lialis leptorhyncha Peters, Monatsb. Akad. Wiss. Berl., 1873, p. 605.

Lialis burtonii Boulenger, Brit. Mus. Cat. Lizards, i, 1885, p. 247. *Id.*, Gray, in Grey's Two Expeditions, ii, 1841, p. 437, pl. iii, fig. 1; and Zool. "Erebus" and "Terror," Rept., 1845, p. 5, pl. viii, fig. 2; *Id.*, Günther, Ann. Mag. Nat. Hist., (3) xx, 1867, p. 46.

Lialis burtoni Werner, Fauna Südwest-Australiens, ii, 1909, p. 4. *Id.*, Rooij, Reptiles Indo-Australian Archipelago, i, 1915, p. 63.



Figs. 1-4. *Lialis burtonis* Gray.

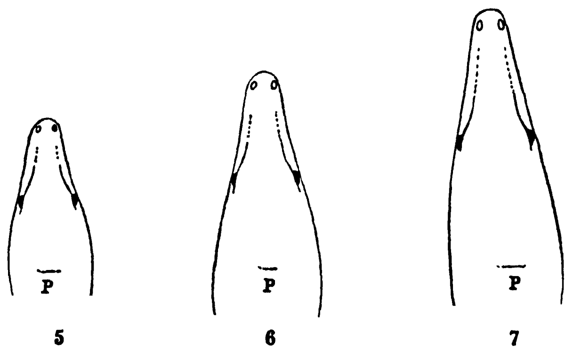
Fig. 1. Dorsal view of head. Fig. 2. Lateral view of head. Fig. 3. Anal region. Fig. 4. Mental region.

Definition.—Head narrow, angular, and depressed. Canthus rostralis angular, sides of head perpendicular. Snout narrow, truncate at tip. Eye small, surrounded by a circular scaly lid. Ear opening oval, oblique, directed backwards. Snout covered above with small plates, more or less irregularly arranged, those on the tip between the nostrils being smallest. Nostril oval, situated in the posterior part of a single nasal shield. Loreal region filled with small elongate scales. Rostral band-like, about twice as broad as high, visible from above. Thirteen to nineteen upper labials, separated from the orbit by two or three rows of small scales. Mental large, variable in shape and size. Twelve to nineteen lower labials, and a row of enlarged, elongate, gular scales, separated from the labials by one or two rows of smaller scales. 19 to 22 rows of scales around the middle of the body; 70 to 100 pairs of ventral scales; 5 anals; 4 preanal pores.

Colour.—The specimens before me show that the colour markings vary even more than those of specimens already described. The ground colour may be brown, olive, grey, or brick red, as well as intermediate tints. The markings of specimens described by Boulenger enabled him to divide them into varieties, but among my specimens there are intermediate forms in many instances, and I find them to be so variable that it would be an unnecessary waste of space and time to make an attempt to describe them here. In passing, it might be worthy of note that, several specimens which should be nearest *var.*

I in the British Museum catalogue, have the under surface of the chin and throat black, with light colored angular markings extending into this dark area from the labial region, while the sides of the head and snout bear irregular, perpendicular, dark lines. The top of the snout is freckled and the top of the head bears several longitudinal dark lines.

Comparative.—Rooij says, "Méhely describes a specimen of *Lialis burtoni* Gray, collected at Erima, Astrolabe Bay, which has 22 scales round the body, two supra-oculars and 6 praeanal pores. Its tail is one time and a half as long as head and body; length of head and body is 270 mm.; tail 423 mm. This specimen probably belongs to the species *Lialis jicari*, as described by Boulenger. In different Museum-collections more examples of the latter species, named now *L. burtoni* Gray will be found on closer examination, as already various authors have given indications of specimens with 22 rows of scales."



Figs. 5-7. *Lialis burtonis* Gray.

Outline drawings to show the extreme variation in the comparative length and breadth of the snout in specimens approximately the same size.

Fig. 5. Total length, 460 mm., tail, 220 mm. Fig. 6. Total length, 420 mm., tail 156 mm. Fig. 7. Total length 420 mm., tail 180 mm.

P = the position of the posterior border of the parietal bone, from which points measurements were taken.

In regard to this statement I would suggest that Méhely's specimen is *L. burtonis* and not *L. jicari*, as the very sharp snout of the latter would have attracted his attention immediately. In support of this I might say that among the specimens of *L. burtonis* before me the scale rows range from 19 to 22, four specimens bearing the latter number. All have the very broad, truncate snout and other characters which are typical of the species.

In the Australian Museum collection there are over sixty specimens of this species, and after thorough examination, I hold the same opinion as Boulenger and other authors—that the degree of elongation of the snout, the scutellation of the head, and the number of scale rows as well as the colour vary considerably.

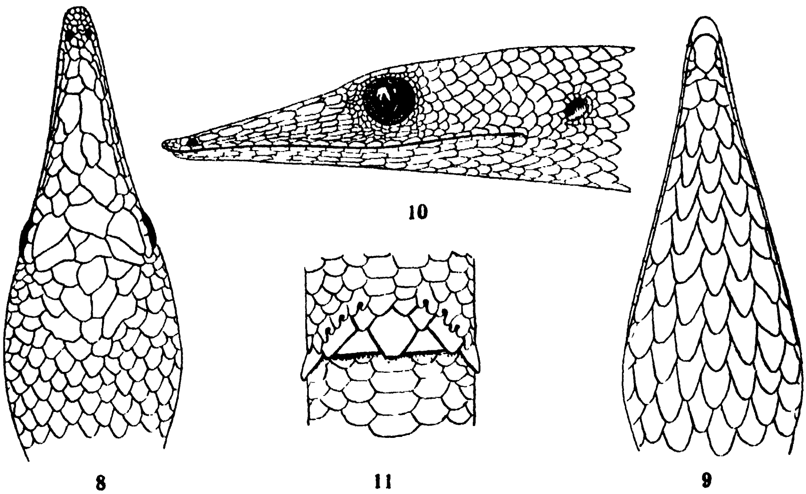
Food.—The food of *Lialis burtonis* appears to consist mainly of other lizards. Unfortunately the internal organs of many of the specimens examined had been removed before preservation, but in twenty which were complete, I found either the remains of, or whole, lizards belonging to the genus *Lygosoma.* In one instance the devoured lizard was so large that it must have caused considerable inconvenience to its swallower during the passage of the jaws; in fact I am sure it would have almost overtaxed the swallowing capacity of a snake the same size as the *Lialis.*

Distribution.—*Lialis burtonis* appears to be distributed widely from British New Guinea, throughout many of the islands of Torres Strait, and extending over practically the whole of Australia and Tasmania.

LIALIS JICARI *Boulenger.*

Lialis jicari Boulenger, Ann. Mag. Nat. Hist., (7), xii, 1903, p. 430. *Id.*, Werner, K. Pr. Akad. Wiss. Berlin, Das Tierreich, 33, 1912, p. 29. *Id.*, Rooij, Reptiles Indo-Australian Archipelago, i, 1915, p. 64. *Id.*, Procter, Proc. Zool. Soc., London, 1923, p. 106.

Alopecosaurus cuneirostris Lidholm, Jahrb. Ver. Nassau, lviii, 1905, pp. 231, 240.



Figs. 8-11. *Lialis jicari* Boulenger.
About 2 1-5th times natural size.

Fig. 8. Dorsal view of head. Fig. 9. Under surface of head showing long mental and rostral.
Fig. 10. Lateral view of head. Fig. 11. Anal area.

This species differs from *L. burtonis* in having a much more sharply pointed and cylindrical snout, and a greater number of preanal pores.

As the several specimens in the Australian Museum collection have certain differences from those already described by Boulenger, Lidholm, and Werner, and as it has not yet been figured, I consider it advisable to give a new definition of the species, and to figure it here for the first time. The definition is compiled from already published descriptions with the added information from the specimens before me.

Definition.—Snout attenuate, acutely pointed, the tip soft, flat and turning slightly upwards. The distance from between the eyes to the tip of the snout is equal to twice the distance across the supraorbitals. Eye small, surrounded by a circular sealy lid, and situated midway between the tip of the snout and the ear opening, which is small, oval and oblique. Pupil narrow, erect. Top of head and snout covered with irregular plates which are smallest on the rostro-nasal area. There are two large supraorbitals, and three elongate scales between these and the eye lid. Rostral a little broader than long when measured along the labial region. Nostril oval, oblique, smaller than the ear. About eight or ten rows of irregular elongate scales between the nostril and the rounded preocular scales.

There are from 17 to 22 upper labials, the thirteenth to the fifteenth being situated under the eye, and three rows of small scales between these and the orbit. Mental longer than broad. 22 rows of scales round the center of the body. Ventrals in 90 to 114 rows. Anals 5-6. Preanal pores 6 to 8.

The total lengths of the specimens known vary from 323 to 755 mm.

Colour.—Greyish, yellowish or pinkish brown above, speckled with black. A faint dark vertebral stripe which divides into two on the head. A well defined dorsolateral stripe which is broader and darker on the sides of the head. Top of head streaked longitudinally with dark brown irregular lines. A light streak on the lower lip extends along the body in the form of a wide band, ill defined from above but sharply defined by a darker line below. There are several longitudinal dark lines on the under surface of the body, of which the centre one is the most distinct and extends forward to the mental. The chin shields are also bordered by dark lines.

Distribution.—*Lialis jicari* would appear to be restricted to New Guinea. Of the twelve specimens known, Boulenger's holotype and cotypes are from Dar, Fly River, British New Guinea: Lindholm's holotype and cotypes of *A. cuneirostris* are from Fly River, British New Guinea; Astrolabe Bay, and Bogadjin near Stephansort, Dutch New Guinea: while the four specimens in the Australian Museum are from the following localities:—Daru Island; Rabaul; Orimo River; and Dar on the Fly River. Miss Procter records it from Lababia, N.E. New Guinea.

STUDIES ON AUSTRALIAN BRYOZOA.

No. I.

By

Arthur A. Livingstone, Assistant in Zoology, Australian Museum.

(Plates xxiii-xxvi, and Fig. 1.)

Until a few months ago a small fleet of trawlers was maintained by the Government of New South Wales, and the collections of the Australian Museum were greatly enriched by large numbers of specimens of all marine groups which were forwarded to this institution by the State Trawling Industry. Facilities were afforded to various members of the staff to make short cruises in the steamers, and I was fortunate enough to have several opportunities of thus making collections. Among the wealth of specimens obtained, I secured a fine collection of Bryozoa, including a valuable series of the interesting *Parmularia obliqua* var. *lobata* from off Norah Head, and an equally interesting collection of the typical form from off Eden, New South Wales.

I have to acknowledge with thanks much valuable advice and criticism afforded to me by my seniors, Messrs. A. R. McCulloch and F. A. McNeill, of the Australian Museum. I am also indebted to Mr. J. A. Kershaw of the National Museum, Melbourne, for the loan of types of *Schizoporella flabellata* Maplestone, and *Lunulites patelliformis* Maplestone.

The three subjects dealt with under the above heading are separated into three sections, each provided with a separate subheading.

A Revision of the Genus Parmularia.

Genus Parmularia *(Busk, M.S.) MacGillivray.*

Parmularia MacGillivray, Proc. Roy. Soc. Victoria, xxiii, 1887, p. 211.

"Zoarium foliaceous, bilaminate, attached by a large, flexible radical tube. Zooecia oblique." (MacGillivray.)

Two species, believed to be undescribed, are included in this hitherto monotypic genus. I have also redescribed the genotype, and have recorded some additional synonymy.

Parmularia obliqua *MacGillivray.*

(Plate xxiii, figs. 1-2; Plate xxv, fig. 1; Plate xxvi; and Fig. 1.)

Eschara obliqua MacGillivray, Trans. Proc. Roy. Soc. Vict., ix, 2, 1868, p. 137.

Eschara reniformis Kirchenpauer, Mus. Godeffroy Cat. iv, May 1869, p. xxviii.

Parmularia obliqua Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 201 (synonymy).

Schizoporella flabellata Maplestone, Trans. Proc. Roy. Soc. Vict., (n.s.), xiv, 2, 1902, p. 68, and Rec. Austr. Mus., vii, 4, 1909, p. 268.

Parmularia obliqua and *flabellata* Maplestone, Trans. Proc. Roy. Soc. Vict., (n.s.), xxiii, 1, 1910, p. 42, pl. x.

Parmularia obliqua Maplestone, Trans. Proc. Roy. Soc. Vict., (n.s.), xxv, 2, 1913, p. 360.

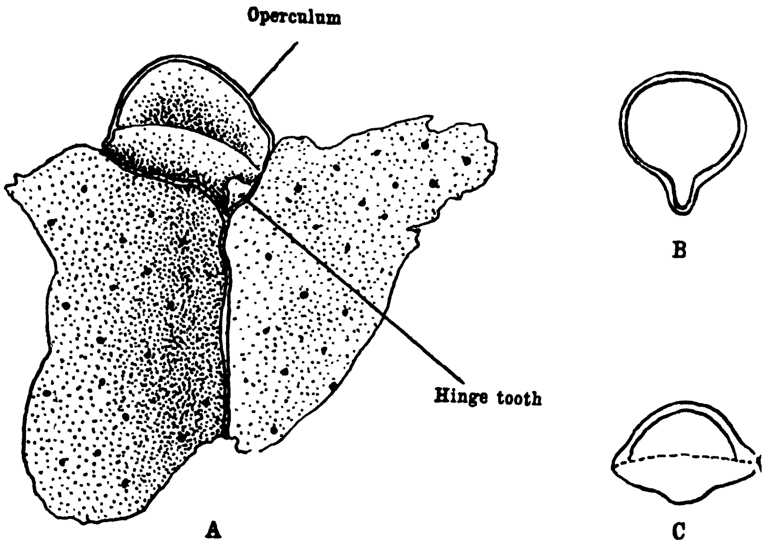


Fig. 1. *Parmularia obliqua* MacGillivray.

A. Diagram showing the under surface of the frontal wall of an ooecium-bearing zooecium and the attachment of the operculum to the hinge tooth.

B. Operculum of a barren zooecium.

C. Operculum of an ooecium-bearing zooecium.

Revised description.—Zoarium with two layers of zooecia; flat, and fan or kidney-shaped. The zooecia are separated by well defined furrows along the centre of which are delicate white raised margins.

They are arranged in arched rows which extend outwards from the median base to the lateral margins in the adult forms, but their formation is somewhat variable in younger examples (see notes on variation). The frontal zooecial walls are ovate and thick, invested by a thin transparent membrane, and penetrated by a number of comparatively large pores which are sunken in shallow depressions. The basal zooecial walls are flat and minutely granular. They are provided with from two to five irregularly arranged communication pores. The distal and proximal zooecial walls are curved and roughly "S" shaped. Each is provided with from seven to nine communication pores arranged in a straight row or belt near the base and extending the whole length of the walls. The lateral zooecial walls are more or less straight, and are provided with from four to seven communication pores arranged in one or two rows near their bases. The zooecial apertures are sunken well below the level of the surrounding frontal walls. They are semi-circular distally and produced into a deep sinus proximally. There is a short blunt hinge-tooth on each side of the aperture within the proximal half. The peristome is weakly developed, and in some zooecia is barely discernible, though in others it is produced on each side of the sinus. The operculum is yellowish and chitinised, completely enclosing the aperture and the sinus. In ooecia-bearing zooecia, the operculum covers both the aperture of the zooecium and the communicating entrance to the ooecium.

The ooecium appears as a ponderous external structure clearly visible to the naked eye. Its thick frontal wall is dome-shaped, punctured with numerous pores, and furrowed by a deep suture, within which is a raised white margin similar to those separating the zooecia. This suture is branched, dividing the whole frontal ooecial wall into three or rarely four distinct portions. The basal ooecial wall is thin and concave and appears to be membranous. It rests above the junction of two lateral and two proximal zooecial walls, its lowest part being well below the level of the surrounding frontal zooecial walls.

The ooecia-bearing zooecia are considerably distorted, and their individual common apertures are expanded laterally. The peristomes are much more developed than is the case with barren zooecia, and their distal and proximal margins bear thin overhanging lips. On each of the frontal walls, immediately in front of the aperture, a large mucro invariably occurs, which in some cases projects over the aperture and in others is directed straight upwards; this may possess an acute or bifid extremity, or it may be somewhat flattened and tongue-shaped with a blunt or serrated extremity. All this variation of the mucro (which is present only in ooecia-bearing zooecia) is to be found on a single colony before me.

Colour.—Recent examples are salmon-coloured in life, but soon fade to a drab grey or white when dried or preserved in alcohol; when viewed under the microscope they appear to be much whiter than when seen with the naked eye.

Mode of attachment.—On the base of a large dry specimen before me is a membranous filament which serves to anchor the colony to the sandy bottom on which the species is known to occur. This is about 25 mm. in length and in its dry and shrivelled condition is flattened and tape-like. One end is widened and fits into a shallow and narrow concavity at the base of the colony. The other end is provided with root-like projections. The roof of the concavity at the base of the colony is provided with a number of thin lamellæ, which either extend uninterruptedly from side to side or fuse with others at various intervals.

Synonymy and variation.—Maplestone separated his *Parmularia flabellata* from *P. obliqua* on the arrangement of the zooecia and the shape of the zoarium. These characters are subject to great variation with age, however, and cannot be relied upon to distinguish the two species.

By the courtesy of Mr. J. A. Kershaw, Curator of the National Museum, Melbourne, I have been able to examine the type of Maplestone's *S. flabellata,* which is 4 mm. long and 2.5 mm. wide; others agreeing with it in all details are preserved in the Australian Museum. I have carefully compared these specimens, including the type, with numerous other examples in the Australian Museum which agree with the description and figures of *P. obliqua*, and which I regard as referable to that species. As a result of this comparison I have come to the conclusion that *P. flabellata* is synonymous with *P. obliqua*. The dredgings secured from a depth of 40 fathoms in Oyster Bay, Tasmania, by the Commonwealth Fisheries Investigation Ship "Endeavour" are particularly rich in examples of both *P. obliqua* and *P. flabellata*, and I am able to sort out a series of specimens completely connecting the two forms. None but juvenile specimens possess the same zooecial arrangement as the type of *P. flabellata*. The small colonies exhibit a perpendicular arrangement of the zooecia as described and figured by Maplestone, and gradually assume the oblique arrangement as the adult condition approaches. Generally the shape of the zoarium differs with age from a juvenile elliptical form like Maplestone's type, to an adult fan- or kidney-shaped colony, but other variable shapes have been noticed (Pl. xxv, fig. 1). These are sometimes irregular two lobed colonies somewhat resembling the var. *lobata* form, or may be roughly triangular in outline. Such growth irregularities, however, are recognised as being by no means uncommon among the Bryozoa.

In support of the above synonymy it may be noted that Maplestone (*loc. cit.* 1910) moved his *flabellata* from *Schizoporella* to the genus *Parmularia,* even though this latter has the zooecia arranged obliquely. He therefore noted that *flabellata* "differs from *P. obliqua* in that the zooecia are perpendicularly arranged, not obliquely." This caused me to look into the matter more closely, with the above results. Further, it is interesting to note that the two colonies identified

by Maplestone as his *flabellata* from the material secured by the H.M.C.S. "Miner" (*loc. cit.* 1909) are intermediate growth stages between *P. obliqua* and *P. flabellata*. A careful study of these specimens in the Australian Museum collection shows that they are elliptical colonies, a little larger than Maplestone's type, and both possess clear indications of the commencement of an oblique zooecial arrangement.

The species has been recorded from the following localities:—Schnapper Point, Victoria (MacGillivray); Bass Strait, south eastern Australia (Kirchenpauer); Jimmy's Point, Reeves River, Victoria (fossil); 80 fathoms, 22 miles east of Port Jackson, New South Wales; Backstairs Passage, South Australia; Gulf of St. Vincent, South Australia, 14 to 24 fathoms (Maplestone).

There are additional specimens in the Australian Museum from:—Albany Passage off Cape York, Australia, 5 to 15 fathoms, collected by Messrs. C. Hedley and A. R. McCulloch, October, 1907; 3-4 miles off Eden, New South Wales, 25-30 fathoms, collected by Messrs. F. A. McNeill and A. A. Livingstone; off Gabo Island, Victoria, 100 to 200 fathoms, collected by the Commonwealth Fisheries Investigation Ship "Endeavour," 1909-14; Port Phillip Heads, Victoria; Oyster Bay, Tasmania, 40 fathoms; Spencer Gulf, South Australia, 16 fathoms, 20-8-1909, collected by the C.F.I.S. "Endeavour," 1909-14.

PARMULARIA OBLIQUA *MacGillivray*, var. LOBATA *Maplestone*.

Maplestone, Trans. Proc. Roy. Soc. Vict., (n.s.)xxv, 2, 1913, pp. 360-1, pl. xxviii, fig. 11.

The characters of this variety are well defined by Maplestone, who had specimens from King George Sound, West Australia. I regard several specimens in the Australian Museum from off Norah Head, New South Wales, 26 to 38 fathoms, as referable to the same variety. They were collected by myself while on the trawler "Goonambee" during 1921, and form the second record of the occurrence of the variety.

The specimens before me are as irregular in outline as those figured by Maplestone. They do not differ in structural details from the typical form, but superficially appear to be much more delicate and not nearly so heavily calcified. The colour of the specimens when fresh was the same salmon hue as that of the typical form, but in the dried state they have taken on a silvery appearance which I have not noticed in that species. It is a striking fact that no similarly conditioned specimens were found in the great bulk of typical *P. obliqua* material in the Australian Museum.

Localities.—King George Sound, West Australia (Maplestone); off Norah Head, New South Wales, 26 to 38 fathoms, collected by Messrs. F. A. McNeill and A. A. Livingstone, June, 1921.

PARMULARIA MACNEILLI[1] *sp. nov.*

(Plate xxiv, figs. 1-2; and Plate xxv, fig. 2.)

Description.—The zoarium is elongate, roughly elliptical, and tapers towards the distal extremity; it is two-layered, flat, and extremely delicate. The zooecia are bigger than those of *P. obliqua*, and larger near the edges of the colony than in the centre. They are like those of *P. obliqua* in form and arrangement, but are much less heavily calcified, and the frontal walls are less convex. They are somewhat diamond-shaped, with their distal and proximal walls curved in the same S-shaped manner, and with their lateral walls almost straight. They are separated by distinct furrows, within which are barely discernible white raised margins. The frontal zooecial walls are covered with shallow pits punctured with pores.

The zooecial apertures are usually almost circular, being semi-circular distally and hollowed proximally, but are roundly elongate in some zooecia near the edges of the colony. No sinus is apparent. The peristome is weakly developed distally, but it is produced proximally to form an extremely thin overhanging lip, which is much better developed than in *P. obliqua*. On each side of the aperture and low down in the proximal half, is a small sharply pointed hinge-tooth.

The ooecia are similar to those of *P. obliqua*, but the furrows on their surfaces are shallower, and the white raised margins within them are not so conspicuous. The apertures of the ooecia-bearing zooecia, although distally adapted to accommodate the ooecia, retain their general shape, and are not subject to the same degree of distortion as in *P. obliqua*.

Attachment.—There is an elongate concavity at the base of the colony for the accommodation of an anchoring tube, but it is much smaller and less developed than in colonies of *P. obliqua* of the same superficial area. The arrangement of the lamellæ, however, is the same.

Remarks.—This species is found living in the same localities as *P. obliqua*, but is a much rarer form. Consequently, having only a limited number of specimens, I cannot spare material to section for the study of internal details.

Colour.—Dried specimens are a light rusty cream in colour.

Holotype.—Described and figured from a colony 14.5 mm. long and 6 mm. wide from off Gabo Island, Victoria, 100-200 fathoms. Two additional specimens (paratypes) from the same locality are in the Australian Museum collection, together with some small fragments.

Localities.—Off Gabo Island, Victoria, 100-200 fathoms, collected by the Commonwealth Fisheries Investigation Ship "Endeavour," 1909-14.—Holotype and paratypes.

[1] Named for Mr. F. A. McNeill, Zoologist at the Australian Museum, Sydney.

East from Babel Island, Bass Strait, 65 fathoms, collected by the C.F.I.S. "Endeavour," 26th October, 1912. Fragments.

Lagoon at Masthead Island, Capricorn Group, Queensland, collected by Messrs. C. Hedley and A. R. McCulloch, October, 1904; one incomplete colony.

PARMULARIA INTEGER *sp. nov.*

(Plate xxiii, fig. 3.)

Description.—The zoarium is elongate and elliptical like the preceding species, and is two-layered and flat; like *P. obliqua* it is heavily calcified. The zooecia are small, similar in shape to those of *P. obliqua*, and arranged in similar oblique series. They are separated by shallow furrows, the margins within which are very obscure, much as in *P. macneilli.* The thickened zooecial walls are slightly ovate as in that species, and the distinct pits on their surfaces are perhaps punctured with small pores as in other members of the genus. If present, these pores are obliterated by an accumulation of silt, but as I have only a single colony I cannot risk its destruction by any attempt to clarify the frontal walls. The apertures are irregularly circular, and, as in the two allied species, are sunken below the level of the surrounding frontal walls. The peristome is only weakly developed, and barely discernible; no sign of an overhanging lip is present. On each side of the aperture and low down in the proximal half, is a minute hinge-tooth, but in some of the apertures these are worn off. Immediately outside the proximal border of the aperture is a small, sharp, mucro-like denticle which points towards the distal extremity of the zooecium. There are no ooecia present on the colony examined.

Colour.—The colony is white when dried.

Mode of Attachment.—The presence of a concavity at the base of the colony suggests that *P. integer* is attached, like the other two species of *Parmularia*, by a flexible tube. But, unlike those of its allies, the lamellæ in the concavity are only weakly developed, and the base of the opening is punctured by comparatively large pores of varying sizes.

Holotype.—Described and figured from a single colony, 5 mm. long and 3 mm. wide, which was collected by Messrs. C. Hedley and A. R. McCulloch in lagoon at Masthead Island, Capricorn Group, Queensland. It is possibly juvenile, and, although the zooecia appear to have assumed the adult characters, I have no means of determining whether the shape of the zoarium is constant or not. The specimen is housed in the Australian Museum.

Locality.—The lagoon at Masthead Island, Capricorn Group, Queensland; collected by Messrs. C. Hedley and A. R. McCulloch, October, 1904.

Affinities.—This species resembles the fossil species *Lepralia obliqua* MacGillivray[2] in being bilaminate, destitute of avicularia, and in the position of the aperture. But if *L. obliqua* be a true *Lepralia*, the two must be distinct, for *P. integer* has the zooecia arranged in an arched direction laterally as is characteristic of *Parmularia;* further they are not distinctly "separated by prominent raised lines" as in *L. obliqua.* Again the lower lip is not "convex upwards forming a mucro-like projection"; the mucro-like denticle referred to in my description is quite distinct and separate from the lower lip.

It may be considered that *L. obliqua* should be placed in the genus *Parmularia*, but the only character it has in common with this genus is the bilaminate formation of the zoarium. MacGillivray states that the "thyrostome [aperture] is straight or generally oblique," but gives no information as to how the zooecia are arranged. Further, as he was responsible for the genus *Parmularia*, he doubtless had good reasons for placing *obliqua* in *Lepralia* rather than in *Parmularia.* From his description it would appear that he founded his species on fragmentary material.

Key to the species of *Parmularia*:

A. Aperture with a sinus.
  B. Colony lobed, kidney- or fan-shaped. *obliqua.*
AA. Aperture without a sinus, zoarium roughly elliptical.
  C. A mucro-like denticle immediately below proximal border of aperture. *integer.*
  CC. No such denticle. *macneilli.*

MISCELLANEOUS NOTES.

This section has been made to accommodate notes of special interest, together with a description of a species of *Arachnopusia* believed to be new to science.

Genus PETRALIA *MacGillivray.*

PETRALIA JAPONICA *Busk.*

Lepralia japonica Busk, Challenger Rep., Zool., x, 30, 1884, p. 134, pl. xvii, fig. 5. *Id.*, Waters, Journ. Linn. Soc. Zool.. xxxi, March, 1909, p. 149, pl. 13, figs. 10-12 (synonymy).

Petralia japonica Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 352, pl. xviii, figs. 5 a-b.

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[2] MacGillivray—Trans. Roy. Soc. Vict., iv, 1895, p. 78.

A specimen recently collected by Mr. E. H. Rainford on the beach at Gloucester Island, Bowen Harbour, in Port Denison, Queensland, which I identify as this species, assumes the hemescharine habit, forming free and erect expansions. These branching expansions are, however, tubular and somewhat cylindrical, the individual branches ranging from 3 to 6 mm. in diameter. The specimen is a mass of these tubes all joined together, the whole measuring about three and a half to four inches across. The ooecia are well represented on the specimen secured by Mr. Rainford, and are embedded beneath the frontal walls of zooecia situated distally to the ooecia-bearing zooecia. The frontal wall of such a distal zooecium when removed reveals plainly the internal ooecium which encroaches upon half, or a little less than half of the space of the cell. Both the frontal and basal ooecial walls are perforated by a number of minute pores, but the frontal walls more so than the basal. In some specimens the zooecia are heavily calcified, the peristomes being very thick and prominent.

Levinsen and Waters have so ably dealt with this species that there is very little that I can add to their records. The following localities of specimens preserved in the Australian Museum extend the known distribution of the species as recorded by Waters.—

Localities.—Murray Island, Torres Strait; Albany Passage, North Australia, collected by Messrs. C. Hedley and A. R. McCulloch; Gloucester Island, Bowen Harbour, in Port Denison, Queensland, collected by Mr. E. H. Rainford; rock-pools at Point Cartwright, Queensland, collected by A. A. Livingstone, August 1922; rock-pools at Caloundra, Queensland, collected by A. A. Livingstone, August 1922.

Genus ESCHAROIDES *Milne-Edwards.*

Escharoides Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 317 (and synonymy).

ESCHAROIDES EXCAVATA *MacGillivray.*

Mucronella excavata MacGillivray, Trans. Phil. Inst. Victoria, 1859, iv, p. 166, pl. ii, fig. 4.

Mucronella præstans Hincks, Ann. Mag. Nat. Hist., (5), x, 1882, p. 168, pl. vii, fig. 1. *Id.*, Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 195 (synonymy).

Mucronella excavata Jelly, Syn. Cat. Rec. Mar. Bryozoa, p. 193 (synonymy).

Mucronella præstans Maplestone, Proc. Roy. Soc. Victoria, xvii, 1904, p. 212. *Id.*, Waters, Ann. Mag. Nat. Hist. (7), xvii, 1906, p. 20.

Escharoides præstans Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 318.

Mucronella præstans Maplestone, Rec. Austr. Mus., vii, 4, 1909, p. 268.

This species was first described under the name of *Mucronella excavata* by MacGillivray, and later redescribed by Hincks as *M. præstans*. MacGillivray[3] in 1890 saw Hincks' error and recorded that "this species [his *excavata*] is identical with *M. præstans* described by Hincks from N.Z." Notwithstanding this, the species has been generally referred to under Hincks' name; even MacGillivray referred to it as *M. præstans* in his monograph of the Tertiary polyzoa of Victoria, which he wrote some years after pointing out Hincks' mistake. He either overlooked its identity with *M. præstans*, or considered the two as distinct. I believe he overlooked his remarks made five years before, however, and unwittingly referred to his own species (*M. excavata*) under the name of *M. præstans* Hincks. Miss Jelly in her great work adds *duplicata* and *Lepralia angela* Hutton to the synonymy of *M. præstans*, but lists this latter and *excavata* as separate species. Her remarks as to the priority of *præstans* over Waters' *duplicata* are now invalidated by the fact that the species was described by MacGillivray long before either of these two names was proposed.

The species here discussed is not the *Smittia præstans* referred to by Waters[4], which was later queried by Levinsen as being synonymous with his *Escharoides sauroglossa sp. nov.* I may here point out that *Smittia præstans* Waters, *var.* was referred to by Canu and Bassler[5] under the heading of *Romancheina prestans*[6] *var.*, Waters, 1889 (not Hincks). These distinguished authors evidently overlooked or do not accept Levinsen's suggested synonymy.

Genus LUNULARIA *Busk*, 1884.

Lunularia Canu and Bassler, Bull. U.S. Nat. Mus. No. 106, 1920, pp. 238-252.

These authors quoted above have recently dealt with the status and history of this genus, and have supplied a complete list of the known species.

LUNULARIA CAPULUS *Busk*.

Lunulites capulus Busk, Brit. Mus. Cat. II, 1854, p. 100, pl. cxii.

Lunularia capulus Busk, Challenger Rep. Zool., x, 30, p. 208, pl. xiv, fig. 7a.

Lunulites patelliformis Maplestone, Trans. Proc. Roy. Soc. Vict. (n.s.) xvi, 1904, p. 215, pl. xxv, figs. 6a-b.

Lunularia capulus Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 155.

3 MacGillivray—Trans. Roy. Soc. S. Austr., vol. xiii, 1890, p. 5.
4 Waters—Ann. Mag. Nat. Hist., (6), iv, 1889, p. 17.
5 Canu and Bassler—U.S. Nat. Mus. Bull., 106, 1920, p. 407.
6 Evidently a misprint for *præstans*.

Lunularia capulus and *patelliformis* Canu and Bassler, Bull. U.S. Nat. Mus. No. 106, 1920, pp. 238 and 239, text fig. 46.

Selenaria livingstonei Bretnall, Rec. Austr. Mus. xiii, 5, 1922, p. 190, text fig. 2.

Lunulites cupulus Waters, Journ. Linn. Soc., xxxiv, 1921, p. 417.

Synonymy.—A comparison of the holotype and paratypes of *S. livingstonei* in the Australian Museum with specimens of *Lunularia capulus* Busk proves that the two are identical. The diagnosis given by Bretnall is quite inadequate, as it embodies only the superficial characters, and makes no mention of the structures beneath the depressed cryptocysts of the zooecia. Further his figure of the zooecial detail is misleading in that it shows no indication of the apertures. He states that "small circular vibracular cells are situated between the zooecial rows over the entire surface," but in a partly worn paratype, and another incinerated example, the vibracular cells are elongate and somewhat elliptical and pointed towards the apex of the zoarium; they therein agree with the figure given by Busk *(loc. cit.)*.

Through the kindness of Mr. J. A. Kershaw, Curator of the National Museum, Melbourne, I have been able to examine the type specimen of Maplestone's *Lunulites patelliformis*, and, after a critical examination, have no hesitation in associating it with *L. capulus* Busk, thereby proving portion of the synonymy hinted at by Waters *(loc. cit.)*. According to Maplestone, the lateral walls of his *L. patelliformis* are provided with four communication pores. I have been unable to examine this character in the type without risk of serious damage to the specimen, but I find that the number and arrangement of these pores is variable in the lateral walls of zooecia of individual colonies in the Australian Museum collection. The under surface of the zoarium is also variable, both in the number of pores present and in the arrangement of the radiating ridges. Again, it is apparent that the character of the flagellæ (vibracular mandibles) undergoes considerable variation, these structures being short in some colonies, long and slender in others. The extremities are mostly trifid, but a few isolated acutely pointed flagellæ are often found on a single colony, which are similar in shape to the flagellum described and figured by Maplestone.

The only complete flagellum to be found on his type is a single club-topped example, which no doubt was once trifid, and there is every indication that its extremity is considerably worn. So far as I can ascertain, all other flagellæ are either completely worn off or are broken and damaged.

The following notes on the variation of the flagellæ of *Lunularia capulus* have been compiled after an extensive study of the specimens in the Australian Museum, together with the types of *L. patelliformis* and *S. livingstonei*. The extremities of the flagellæ on specimens from 3 to 4 miles off Eden, New South Wales, 25 to 30 fathoms, and those on the type of *S. livingstonei* are either acute or trifid, though the latter form is by far the commonest. The flagellæ are long and slender,

and appear at first sight to be almost round; when examined under a microscope however, each is seen to possess a central axis which extends along its whole length, and on each side of this axis is a flattened expansion. Although this character is but little developed in *L. capulus*, the flagellæ are somewhat similar to those of *Lunularia repandus* Maplestone[7], and their extremities are acute or trifid in both species. Despite this and other resemblances, I think *L. repandus* possesses sufficient characters to distinguish it from its allies.

Localities.—Specimens of *Lunularia capulus* are in the Australian Museum from:—Newcastle, New South Wales, 1866; 3 to 4 miles off Eden, New South Wales, 25 to 30 fathoms, collected by Messrs. H. O. Fletcher and A. A. Livingstone, 1922; "Thetis" Expedition, Station 28,—2 to 4 miles off Manning River, New South Wales, 22 to 23 fathoms, 1898; "Thetis" Expedition, Station 49,—5 to 8 miles off Port Kembla, New South Wales, 63 to 75 fathoms, 1898.

The species has been recorded elsewhere from:—Off Cape Capricorn (MacGillivray); "Challenger" Expedition, Station 161, off Port Phillip, Victoria, 33 fathoms, sand (Busk); 26 to 38 fathoms off Norah Head, New South Wales (Bretnall); St. Vincent Gulf and Backstairs Passage, 17 to 22 fathoms; Investigator Strait, South Australia, 15 to 20 fathoms; Newcastle, New South Wales (Maplestone).

SCHIZOPORELLA ACUMINATA *Hincks.*

Schizoporella acuminata Hincks, Ann. Mag. Nat. Hist. (5) viii, 1881, p. 14, pl. ii, fig. 1.

Schizoporella jacksoniensis Busk, Challenger Rept. Zool. x, 30, 1884, p. 164, pl. xix, figs. 3, 3a-b.

Schizoporella jacksoniensis Whitelegge, Journ. Proc. Roy. Soc. N.S. Wales, xxiii, 1889, p. 125.

Schizoporella jacksoniensis Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 299 (synonymy).

Schizoporella acuminata Jelly, Syn. Cat. Rec. Mar. Bryozoa, 1889, p. 221.

Schizoporella acuminata Hincks, Ann. Mag. Nat. Hist. (6) viii, 1891, p. 477.

Schizoporella acuminata Maplestone, Proc. Roy. Soc. Vict. (n.s.), xvii, 1, 1904, p. 206.

This species was first described by Hincks from a specimen from Bass Strait. Three years later Busk described the same species under another name, from material secured by the "Challenger" off Port Jackson, New South Wales.

[7] Maplestone—Trans. Proc. Roy. Soc. Vict (n.s.), xvi, 1904; p. 216, pl. xxv, fig. 7 a-c; and Waters Journ. Linn. Soc., vol. 34, No. 229, 1921, p. 417.

Material in the Australian Museum was dredged by the "Thetis" at Station 44 (5-6 miles off Coogee, New South Wales, 49-50 fathoms; fine sand, 1898), only a few miles away from the locality of the type of *Schizoporella jacksoniensis* Busk. These specimens agree with Busk's description and figures, and like his specimens were found encrusting the stem of a hydroid or alcyonarian. These specimens further agree with Hincks' description of *S. acuminata* in all characters except the structure of the cell wall. According to him, there is an "acuminate suberect extension of the cell-wall behind the orifice, the apex or peak of which is slightly bent forward, and occupied by a smooth somewhat nodular prominence." But, after examining specimens in the Australian Museum, I agree with Waters that this is not a constant character.

The ooecia of *S. jacksoniensis* are the same as those of *S. acuminata*. I find some variation in the occurrence of the avicularia, which may be entirely absent on some zooecia; in others they are represented by one on one side of, or a little below the aperture and directed upwards, or else by one on each side, which may be on the same level as, or a little below the aperture.

The species has been recorded from the following localities:—Off Curtis Island, Bass Strait, not more than 40 fathoms (Hincks, type locality); "Challenger" Expedition, Station 163b, off Port Jackson, New South Wales, 35 fathoms, hard ground (Busk); Bairnsdale, Gippsland, Victoria, fossil; Mount Gambier, South Australia, fossil (Waters).

There are specimens in the Australian Museum from:—"Thetis" Expedition, Station 44, 5-6 miles off Coogee, New South Wales, 49-50 fathoms, fine sand, 1898; Port Phillip, Victoria; "Miner" Expedition, 22 miles east of Port Jackson, New South Wales, 80 fathoms (these specimens were found in a small box, together with specimens of *Schizoporella cecilii*, which were identified as such by Maplestone). Off Point Plomer, New South Wales, 50 fathoms, dredged by Mr. C. Hedley, 14-10-1918; Muddy Creek, Victoria, fossil, presented by Rev. T. Porter, 1904.

SCHIZOPORELLA CONVEXA *MacGillivray*.

Schizoporella convexa MacGillivray, Trans. Roy. Soc. Victoria, iv, 1895, p. 85, pl. xi, fig. 21.

Schizoporella convexa Maplestone, Trans. Roy. Soc. Victoria, (n.s.) xiv, 2, p. 66, pl. vi, fig. 4, (not pl. vii as stated).

This species was described by MacGillivray as a fossil from the Tertiary deposits at Muddy Creek, Victoria, Maplestone later recognised it from the Mitchell River deposits, Victoria, and described and figured the ooecia.

Variation.—A few fragmentary specimens of this species were obtained by the "Thetis," which were found completely encrusting a piece of weed, and some zooecia of which possess avicularia. These occur singly, either on the right or left of each aperture, and are directed laterally. Sometimes the avicularium is situated on the proximal half of the frontal zooecial wall, in which cases it is directed proximally. The mandibles are fairly large and duck-bill shaped. The avicularian chambers are deep.

The ooecia are like those described and figured by Maplestone but his distal "cross-ribbed depressed area" is punctured with large elongated pores in my specimens. The basal wall of an ooecium possesses small pores.

Distribution.—Muddy Creek, Victoria, Tertiary (MacGill., type locality); Mitchell River, Victoria, Tertiary (Maplestone).

There are specimens in the Australian Museum from:—"Thetis" Expedition, Station 44, 5-6 miles off Coogee, New South Wales, 49-50 fathoms, fine sand (recent); "Thetis" Expedition, Station 48, 7-8 miles off Wollongong, New South Wales, 55-56 fathoms, sand and mud to rock (recent).

Genus ARACHNOPUSIA *Jullien*, char. emend.

Arachnopusia Levinsen, Morph. Syst. Stud. Cheil. Bryozoa, 1909, p. 160.

ARACHNOPUSIA AJAX *sp. nov.*

(Plate xxiv, fig. 3.)

Description.—Zoarium encrusting, very thick and stout. The zooecia are broadly ovate, and under a high power microscope appear to be very uneven in height; this may be accounted for by the fact that the colony has accommodated itself to the irregularities of the surface it is encrusting. They are separated by thick, stout and slightly raised margins. The aperture, which is broader than long, is semiorbicular in shape, arched above and straight below, and protected by a stout operculum. There are generally three, stout, projecting hollow spines, situated directly above the aperture. A rod-like chitinous opercular valve is situated on the outside edge of the proximal border of the peristome, and a little to one side of the median line. In many cases its total length is about three times the height of the aperture. Peristome well developed. Frontal wall punctured by a number of large irregularly rounded pores, the average number to each zooecium being about twenty-eight. The avicularia have triangular mandibles, and are irregularly scattered along the wide raised margins of the zooecia; they are generally very plentiful in the vicinity of the peristome. There are no avicularia on the frontal wall. Ooecia are not present on the specimen.

Locality.—Off Botany Bay, New South Wales, 400 fathoms (one small fragment).

It is near *Arachnopusia monoceros* (Busk), but differs from it in the following features:—The peristome on the lower lip is without even indications of being raised into a central pointed process or mucro. The zooecia are about twice as large as those of *A. monoceros*, and are distinctly separated by wide raised margins, along which are scattered the avicularia. The opercular valve does not emerge from within the peristome as it does in *A. monoceros.*

ARACHNOPUSIA MONOCEROS *Busk*.

Lepralia monoceros Busk, Brit. Mus. Cat. ii, 1854. p. 72.

Cribrilina monoceros MacGillivray, Prod. Zool. Victoria, xx, p. 319, pl. 187, fig. 6. *Id.*, Jelly, Syn. Cat. Rec. Mar. Bryozoa, p. 67 (synonymy).

Hiantopora perforata Maplestone, Rec. Austr. Mus. vii, 4, 1909, p. 271, pl. lxxviii, fig. 9.

Arachnopusia monoceros Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 160. *Id.*, Canu and Bassler, U.S. Nat. Mus., Bull. 106, 1920, p. 312, fig. 86 A-J.

Synonymy.—This well-known species was redescribed as *Hiantopora perforata* by Maplestone *(loc. cit.)* in his report upon the results of the deep sea investigations of the H.M.C.S. "Miner." The type specimen of *H. perforata* is housed in the Australian Museum, and has been examined and compared with specimens identified as *Cribrilina monoceros* by earlier workers in this institution, as well as with descriptions and figures given by various authors. As a result of this I conclude that the two species are identical. It may be noted that Levinsen *(loc. cit.)* in his great work on the cheilostomatous bryozoa pointed out that there appeared to be a number of different forms confused under the name *Arachnopusia monoceros*, but I arrive at the conclusion that the forms which appear to differ so greatly from *A. monoceros* are only growth stages of that species.

Maplestone's type is a "dead" specimen, being worn and partially encrusted with dry ooze and sand, but the characters are nevertheless fairly clear and distinct. In Maplestone's description of *H. perforata* he states "The pores on the surface of the zooecia are not always open; many are closed with a calcareous layer which in some bears a small perforation." Having examined his type specimen, I conclude that the so-called calcareous layers are merely dried ooze and fine sandy material encrusted around the inner edge of the lacunæ (pores). The small perforation in the so-called calcareous layer is evidently the central portion or middle of the lacunæ which is not encrusted with the dried ooze, for the centre is always first to fall away naturally from such structures as these when the whole is dry.

The lacunæ in the type specimen are not semilunar, but somewhat irregular in shape, and the majority do not appear to possess the internal denticule. Such lacunæ are figured by Busk in the British Museum catalogue for his *L. monoceros*. My experience of the lacunæ in this species is that they vary, some being semilunar with the internal denticule, while others are round or irregular in outline, both forms occurring in the one colony.

Maplestone states that the "thyrostomes are very irregular in shape owing to the presence sometimes of more than one mucro." His type specimen shows only one mucro on the proximal border of the aperture, never two. Apparently he did not realise that each mucro was surmounted by an avicularium (which is the case on the type specimen) and that it was the concavity made for the reception of this avicularium that created the two points at the apex of the mucro. It must have been the bifid extremity of the mucro caused by the avicularian cavity that caused Maplestone to believe that there were sometimes more than one mucro present. This is the only explanation I can offer to account for his remark. He further states that some zooecia possess only one mucro. In such examples as can be found on the type, the mucro is worn down, almost obliterating all traces of the avicularium. It must have been these that he took for single mucros.

The "lateral processes" at the basal end of the avicularian cavities described by Maplestone are really only the remains of the central cross-bar which reaches from one side of the avicularian cavity to the other. I have found one complete cross-bar in an avicularian cavity on the type specimen of *Hiantopora perforata*.

A synopsis of the recent Australian species of *Arachnopusia*.

Arachnopusia monoceros Busk.—Opercular valve on one side within the peristome. Mucro situated on the proximal lip of the peristome but barely discernable in young specimens. Three small spines, sometimes furcate, situated above the aperture. Zooecia not distinctly separated.

Arachnopusia acanthoceros MacGillivray.—Mucro absent. Lower lip straight. Opercular valve usually large and branched or prickly, and situated immediately below the lower lip to one side of the median line. Zooecia not distinctly separated.

Arachnopusia ajax sp. nov.—Mucro absent. Lower lip straight. Opercular valve destitute of prickles or branches, situated immediately outside the aperture, and upon the lower lip to one side of the medial line. Zooecia distinctly separated by broad raised margins, along which are scattered numerous avicularia.

On the Genera and Species of the Conescharellinidæ.

Literature dealing with the recent species and genera of this family, and particularly of *Conescharellina*, is in such a state as to make definite specific determinations exceedingly difficult. The admirable work of Levinsen on the family is unfortunately incomplete as he deals with only one or two species of each genus. Whitelegge recognised the affinity of various species allocated to other genera and associated them under the name *Bipora*. In 1921, Waters published a report upon the relationships of the *Selenariidæ* and the *Conescharellinidæ* in which much is added to our meagre knowledge of these families. Much work remains to be done on the species before a more substantial classification can be proposed. With this end in view I aim to deal here for the most part with a consideration of the status of some Australian species, particularly those named by Maplestone, which, since their description, have remained in total obscurity. Having compared the collection of representatives of the family in the Australian Museum with published works by various authors on the subject, I am able to submit the following notes as a contribution towards our knowledge of the species, and particularly of the genus *Conescharellina*.

Types of Bryozoa described by Haswell.—The only Bryozoa material from Holborn Island, Queensland, now in the Australian Museum, is that on which Haswell[8] based the major portion of his report. It was collected by him while he was the guest of Dr. Coppinger on board the H.M.S. "Alert."

Mr. Whitelegge informs me that Prof. Haswell did not label his types, or any other specimens with any information other than the locality. Small fragments of the species described were placed by Haswell in small glass phials and were later mounted on slides by Whitelegge, who identified them by means of Haswell's report on the Holborn Island and Port Denison material. These must be accepted as the types of Haswell's species.

Levinsen's definitions of the genera in this family have been adopted.

Bretnall[9] stated that a new species of *Bipora* was secured in a collection made off Norah Head, New South Wales, and added that the description was being dealt with elsewhere. This description was not published, however, and the form he thought to be new proves to be *Parmularia obliqua* MacGillivray.

Genus Conescharellina *D'Orbigny.*

Conescharellina angulopora *Tenison-Woods.*

Lunulites angulopora Ten.-Woods, Trans. Roy. Soc. S. Austr., iii, 1879-80, p. 7, pl. i, figs. 3a-c.

[8] Haswell—Proc. Linn. Soc. N.S.W., v, 1, August, 1880, p. 33.
[9] Bretnall—Rec. Austr. Mus., xiii, 5, 1922, p. 189.

Lunulites incisa Hincks, Ann. Mag. Nat. Hist., (5), viii, 1881, p. 127, pl. vi, figs. 1-3.

Conescharellina conica Haswell, Proc. Linn. Soc. N.S.W., v. i, 1880, p. 42, pl. iii, figs. 7-8.

Bipora magniarmata Maplestone, Rec. Austr. Mus., vii, 4, 1909, p. 269, pl. lxxv, figs. 3a-b.

Bipora biarmata Maplestone, Rec. Austr. Mus., vii, 4, 1909, p. 268, pl. lxxv, figs. 1a-b.

Conescharellina conica Waters, Journ. Linn, Soc., xxxiv, 1921, p. 423.

The fact that the descriptions of the first three names quoted above were published almost at the same time has led to considerable confusion regarding the identity of the above species. Further, some of the names were founded on characters which, though seemingly distinct and constant, are nevertheless variable and inconstant. This variation confused Maplestone when he described two new forms of *Bipora* obtained by the H.M.C.S. "Miner" during her activities off Port Jackson, New South Wales. These two forms I include in the synonymy of *C. angulopora.*

The following notes are based upon an examination of a large series of specimens in the collection of the Australian Museum.

Variation.—Waters[10] referred to an important avicularian character and stated that "on the cross-bar, besides the central ligula, there is a smaller one on each side." In a series of specimens I find that these smaller ligulæ are sometimes present and sometimes absent on avicularia of single colonies. The central ligula, though, is constant. The presence or absence of these smaller ligulæ, therefore, should not be considered as a character of any specific value. The shape of the avicularia is also subject to slight variation. The mandibles and the mandibular chambers may be obtusely pointed or slightly rounded at the extremity. Their position on the colony is evidently constant, they being arranged in distinct lines or series between the zooecia, but they may point in various directions. This fact is also noted by Hincks in his description of *L. incisa*. The general shape of the colony is by no means constant, but the conical formation is always present. It may be acutely conical in young specimens (as in the types of *Bipora biarmata* Maplestone) and more broadly conical in the older forms. A specimen from off Norah Head, New South Wales, measures 6 mm. across the base, and 5 mm. from the base to the apex. Another from Holborn Island, Queensland, a cotype of Haswell's *C. conica*, measures 2.2 mm. across the base and 4 mm. from the base to the apex. These figures clearly show the colonies to vary to a considerable extent as regards the possession of a constant proportionate size. The undersurfaces of Haswell's cotypes of *C. conica* from Holborn Island, Queensland, are very variable, and could not be used as a constant specific character, as proved below in the notes on synonymy. The variation is, I believe, due to wear.

[10] Waters—Ann. Mag. Nat. Hist., (5), xx, 1887, p. 199, pl. vi, fig. 26.

Synonymy.—Although Canu and Bassler[11] separate *C. angulopora* and *C. incisa*, and Waters[12] separates the former from *C. conica*, I am unable to find any seemingly reliable and constant characters to distinguish them. I therefore follow Whitelegge[13] in regarding the three as synomymous. Waters[14] was not sure of the status of *C. incisa* and "*Lunulites*" *angulopora*, for he expresses doubt by stating that these two forms may be identical, but in 1921 *(loc. cit.)* he unites them. In separating *C. angulopora* and *C. conica* in the last-mentioned paper he lays stress upon the character of the under surface of the colony to distinguish between the two. For *C. angulopora* Waters records that "the basal wall of the cancelli has a large central perforation with smaller ones around it." I have found this character, however, in some of Haswell's cotypes of *C. conica*, as well as the avicularian crossbar in each of the central perforations in the basal walls of the cancelli.

In separating the two last-named species Waters has split the synonymy as given by Jelly[15] but makes no reference to this fact. Jelly included *C. conica* in the synonymy of *C. incisa* and separated the two from "*Lunulites*" *angulopora*. She saw fit to note under "*L.*" *angulopora*, however, that Whitelegge unites the three.

An examination of the type of *Bipora biarmata* Maplestone, which is housed in the Australian Museum, led me to regard it at first as a valid species. It is very small and possesses acute and roundly pointed avicularia arranged in rows or series between the zooecia, each in turn pointing opposite ways and in a horizontal direction. This character is not constant in other specimens, however, and although the types may appear somewhat different at a glance, when its other characters are compared with those of *C. angulopora*, the similarity of the two is apparent. As there are no definite and constant specific characters that may be used to differentiate these species, I must unite them by placing *B biarmata* in the synonymy of *C. angulopora*.

Bipora magniarmata was described by Maplestone along with *B. biarmata* from the collection secured by the "Miner." Maplestone used the size and number of avicularia, together with the shape and apical angle of the zoarium, to differentiate the species. It has already been pointed out that these characters are unreliable, and, as the remaining characters of *B. magniarmata* are identical with those of *C. angulopora*, one must regard it as a synonym of this latter species. An examination of the type slide of *B. magniarmata*, which is in the Australian Museum, proves Maplestone's figure and description to be a little inaccurate. The figure alone would not lead one to suppose it had been drawn from a specimen identical with *C. angulopora*, but the type is certainly this species, and the figure given by Maplestone is at fault. The ligulate operculum, as Maplestone calls it, is similar to

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11 Canu and Bassler—U.S. Nat. Mus., Bull. 106, 1920, p. 630.
12 Waters—Journ. Linn. Soc., xxxiv, 1921, pp. 422-3.
13 Whitelegge—Proc. Linn. Soc. N.S.W., (2), ii, June, 1887, pp. 343-4.
14 Waters—Ann. Mag. Nat. Hist., (5), xx, 1887, p. 199.
15 Jelly—Syn. Cat. Rec. Mar. Bryozoa, 1889, pp. 64 and 140.

that described by Levinsen[16] for *C. angulopora*. The avicularia are no doubt drawn from a fresh colony (one of which is on the type slide) as it does not illustrate the cross-bar and the attached ligulae, which would be seen on a worn or incinerated example. On the type slide there is such a worn specimen, mounted no doubt by Maplestone himself, yet no figure is drawn from it, and no mention made of the characters exhibited by it in his description. This worn specimen clearly shows the main characters of *C. angulopora*. Further, Maplestone states that there is "no indication of a sinus in the lower lip, probably hidden by the operculum." Each aperture on a colony on the type slide clearly reveals a sinus in the lower lip when the operculum is removed.

Genus BIPORA *Whitelegge.*

Bipora Whitelegge, Proc. Linn. Soc. N.S.W., (2), ii, 1887, p. 340. Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 311.

Zeuglopora Maplestone, Rec. Austr. Mus., vii, 4, 1909, p. 272.

Synonymy.—As noted in the following pages I am unable to find characters to distinguish the genotype of *Zeuglopora (lanceolata)* Maplestone from *Bipora* as defined by Levinsen.

Genotype.—In consideration of Levinsen's revision of Whitelegge's definition of the genus *Bipora* in 1909, Cann and Bassler *(loc. cit.)* have cited *Bipora umbonata* (Haswell) as the genotype.

BIPORA LANCEOLATA *Maplestone.*

Zeuglopora lanceolata Maplestone, Rec. Austr. Mus., vii, 4, 1909, p. 272, pl. lxxviii, fig. 11.

Although Maplestone created a new genus for the reception of this species, I think it is properly referable to *Bipora* Whitelegge. I have examined Maplestone's type and cotype, which are in the Australian Museum, and find that they agree in every detail with Levinsen's amended definition of *Bipora*.

The lunœcia, which evidently escaped Maplestone's notice, are situated at one end and on the side of the cotype colony. The type colony is a permanent mount, and I cannot examine the edges for lunoecia as well. None occur on the flat surfaces of the cotype, nor on the one flat visible surface on the type colony. This species is closely allied to *Bipora umbonata*. Every character pertaining to the aperture, the zooecial structure (except the crenulated edges), the mamilliform nodules, and the avicularia are apparently identical in the two. The only differences are in the possession of crenulated edges on the zoarium, and in the aperture's being provided with "a raised semi-elliptical ridge on the proximal margin, and extending about half-way up the sides," as described by Maplestone. I am not inclined to place

16 Levinsen—Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 311.

too much reliance upon the former character, as the zoaria of these flat forms seem to vary so much, and exactly what specific value the "crenulated edges" of the zoarium have, I am not in a position to say. The one distinctive feature, as noted by Maplestone, is the possession of a calcareous plate on each side of the aperture, which together form the greater part of the peristome, and upon which Maplestone bases the new genus *Zeuglopora*. The peristome may be compared with that of *Conescharellina angulopora* T.-Wds., which it much resembles.

It is noteworthy that Maplestone sorted out from the "Miner" Expedition material two specimens as *Bipora "mamillata"* and "*Zeuglopora*" *lanceolata*, though he did not recognise their similarity.

As Maplestone overlooked many characters in this species, I think it advisable to redescribe it from the single specimen I can handle, the cotype, using Maplestone's phraseology. The description must be incomplete, however, as I have only the one specimen, and none to make sections from to ascertain the internal characters. When these latter are worked out, perhaps other features will be found distinguishing *B. lanceolata* more fully from *B. umbonata*.

Description.—The zoarium is flat and two-layered, lanceolate, with crenulated edges. The zooecia are immersed and undefined. The frontal zooecia walls possess numerous scattered mamillations, between which are situated small round or roundly oval avicularia. Each avicularium possesses a small thin cross-bar without ligulæ. Lunoecia occur sparingly on the edges of the colony. The true aperture is rounded distally and provided with a well-defined sinus proximally. The sinus, like that of *B. umbonata*, is difficult to see from the front, as it is hidden to some extent by the peristome. Situated immediately outside the distal border of the aperture is a well-defined pore as in *B. umbonata*. The peristome is formed by two large calcareous plates, which are situated one on each side of the aperture and continue round the aperture only as a small raised margin on the distal and proximal borders. The peristome at the sides (the calcareous plates) is produced into a sharp point. The crenulated edges of the zoarium, as Maplestone says, is seen to be due to the projection of the lateral zooecia.

Genus BIPORA *Whitelegge.*

BIPORA UMBONATA *Haswell.*

Eschara umbonata Haswell, Proc. Linn. Soc. N.S.W., v, 1, 1880, p. 41, pl. 2, figs. 5-6.

Bipora umbonata Whitelegge, Proc. Linn. Soc. N.S.W. (2), ii, 1887, p. 345.

Bipora mamillata Maplestone, Rec. Austr. Mus. vii, 4, 1909, p. 270, pl. lxxvii, fig.7.

Bipora umbonata Canu and Bassler, U.S. Nat. Mus. Bull. 106, 1920, p. 631, text fig. 193.

Conescharellina mamillata Bretnall, Rec. Austr. Mus., xiii, 5, 1922, p. 191.

When describing *B. mamillata*, Maplestone concluded by admitting that it is "very near *B. (Eschara) umbonata* Haswell." The types of Maplestone's *B. mamillata*, and a series of cotypes[17] of *B. umbonata* Haswell from Holborn Island, Queensland, are in the Australian Museum, and, having critically compared them, I am convinced that they are referable to the one species. Both species have similarly shaped apertures, except for slight variations such as are exhibited in those of individual colonies, and exhibit no characters to distinguish the two species satisfactorily. Maplestone's type clearly shows the anterior pore situated immediately above the distal border of the aperture as well as a sinus in the proximal border. Whitelegge states that this sinus is very hard to see in *B. umbonata*, as it is hidden, together with the true aperture by the peristome. This is correct, but, after careful manipulation of the specimen on its edges under the microscope, I have been able to distinguish the sinus perfectly.

Attention is here drawn to an error made by Bretnall *(loc. cit.)* in placing the species *Bipora mamillata* Maplestone, now *B. umbonata*, in the genus *Conescharellina*. According to Levinsen's definition of *Conescharellina* its representatives must be conical in the shape of the zoarium, whereas Maplestone's type is a true *Bipora* as it is distinctly flat, not conical. The species cannot therefore be left in the genus *Conescharellina*.

On only one specimen of a large series at my disposal have I been able to trace lunoecia. This is the largest example that I have seen, and the lunoecia appear to be situated mostly near the edges of the colony. Whitelegge stated that he was unable to trace them. Canu and Bassler also place this species in the genus *Bipora* and designate it as the genotype.

Bipora umbonata has been recorded by different authors from the following localities:—Holborn Island, Queensland, 20 fathoms (Haswell, type locality); 80 fathoms, 22 miles east of Port Jackson, New South Wales, dredged by the H.M.C.S. "Miner" (Maplestone, type locality of *B. mamillata)*.

Other specimens of the species in the Australian Museum are from:—Albany Passage, north-east Australia, 5-15 fathoms, collected by Messrs. C. Hedley and A. R. McCulloch; Albany Island, 4-14 fathoms, north-east Australia, collected by Messrs. C. Hedley and A. R. McCulloch; Port Denison, Queensland, "Thetis" Expedition, Station 13, 5½-7½ miles off Cape Three Points, New South Wales, 41-50 fathoms, sticky mud and shell; 3-4 miles off Eden, New South Wales, 25-30 fathoms, collected by Messrs. H. O. Fletcher and A. A. Livingstone, 1922.

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[17] See note on Haswell's types and cotypes on p. 205.

BIPORA FLABELLARIS *Levinsen.*

Bipora flabellaris Levinsen, Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 312.

Conescharellina flabellaris Waters, Journ. Linn. Soc., xxxiv, 1921, p. 421 (and synonymy).

In Levinsen's revision of the genera of the *Conescharellinidæ* he proposes the above name for a species allied to *Flabellipora elegans*, from Port Jackson, New South Wales, but differing from it by the possession of lunoecia. He further suggests that this new form should be placed in the genus *Bipora*. All the specimens of this species in the collection of the Australian Museum bear these lunoecia.

Synopsis of the Species of the Genus Bipora.

Bipora umbonata (Haswell).—Zoarium leaf-shaped or trilobed, with two layers of zooecia. Distinguished by the mamilliform appearance of the frontal zooecial walls.

Bipora lanceolata (Maplestone).—Zoarium lanceolate with crenulated edges; two-layered and flat. Frontal zooecial walls mamilliform in appearance. General zooecial characters as for *B. umbonata*, but distinguished by the presence of two calcareous plates at the sides of the aperture, which together form the greater part of the peristome.

Bipora flabellaris (Levinsen).—Zoarium flat and fan-shaped, with two layers of zooecia. Lunoecia and avicularia present. This species can be distinguished from the two above by the absence of the mamilliform nodules on the frontal zooecial walls.

Synopsis of the Species of the Genus Flabellipora.

Flabellipora elegans D'Orbigny.—General characters as for *B. flabellaris* but distinguished by the absence of lunoecia.

Note.—The classification of this species is, to my mind, extremely unsatisfactory.

Synopsis of the Species of the Genus Conescharellina.

Conescharellina philippinensis (Busk). — Zoarium depressed, conical. Zooecial aperture elongate, deeply sunk, and with a wide sinus in the lower border. Peristomial orifice ovate, margin faintly produced. A circular pore situated immediately proximal to the aperture. Lunoecia present. Ooecia external, globose. Circular avicularia.

C. cancellata (Busk).—Zoarium conical, internally cancellated. Aperture almost circular and with a wide sinus below. A raised peristome and a pore immediately outside its distal border. Subcircular, or nearly circular avicularia. Ooecia external.

C. crassa (Ten.-Woods).—Similar to *C. depressa* but differing in having the aperture pyriform, peristome raised, with irregularly disposed pores outside it. Pore above aperture exceedingly large.

C. depressa (Haswell).—Zoarium depressed, conical, or biconvex. Aperture ovate, rounded above and with a wide sinus below. Sometimes a minute denticle on each side of the sinus. Peristome produced triangularly at the sides, and suddenly depressed at the distal and proximal ends of the aperture. A small pore immediately outside the distal border of the peristome. Lunoecia occur sparingly. Triangularly rounded avicularia.

C. angulopora (Ten.-Woods). Zoarium top-shaped. Aperture elongate and oval. A small pore is present above the aperture. Two triangular hinge-teeth in the proximal margin forming a sinus. Peristome formed by two thick calcareous plates projecting sideways and outwards prominently. Round and triangular avicularia. Lunoecia occur sparingly.

C. multiarmata (Maplestone).—Zoarium acutely conical. Aperture irregularly elliptical with a sinus in the proximal margin. Peristome unequally thickened and sometimes surmounted by an avicularium. Exceedingly minute oval avicularia on the surface of the colony in the vicinity of the apertures.

C. ampulla (Maplestone).—Zoarium roundly conical. Zooecia flask-shaped, with long tubular peristomes. Circular avicularia. Juvenile specimens star-shaped.

C. eburnea (Maplestone).—General characters as for *C. cancellata* but differing in that the avicularia are extremely minute, few in number, arranged in pairs above each aperture.

NOTES ON THE OCCURRENCE OF ZEOLITES, ARDGLEN, NEW SOUTH WALES.

By

T. Hodge Smith, Mineralogist and Petrologist.

(Plates xxvii-xxix; Figs. 1-3.)

Some years ago the New South Wales Railway Commissioners opened up a quarry of basalt, situated on the western side of the Great Northern Railway Line, about a quarter of a mile north of Ardglen railway station. The "blue metal" is used by the Commissioners for road-making, ballast, etc. At the present time the quarry face is about a hundred feet high and seventy-five yards wide; from here the Museum obtained over two hundred and fifty specimens, more than half of which were collected by the Director, Dr. C. Anderson, M.A., the remainder being either presented by Messrs. A. Mitchell and H. Gosden or collected by the writer.

At least three distinct basalt flows have been recognised. The uppermost flow is columnar and is separated from the middle flow by an irregular band of very coarse volcanic breccia (Fig. 1). It has yielded only a comparatively few zeolites, the majority having been obtained from the tuff and the middle flow. It is remarkable that, while there is an abundant supply of zeolites, the range of varieties is small.

The Upper Flow (Pl. xxvii, fig. 1): It is impossible to estimate the thickness of this, owing to the eroded state of the surface, but its greatest would be at least a hundred feet. Columnar structure is very well developed; the columns are hexagonal in form and vary from one foot to as much as seven feet in diameter, the former measurement being by far the most common. Almost invariably they are separated from each other by a "selvage," which is in the main only a few millimeters thick, but is as much as ten centimeters in some cases. On the surface of the flow where the rock has been laid bare this "selvage" produces quite a curious effect; the appearance is that of a tessellated pavement, the light-coloured selvage emphasising the effect.

The thin selvage consists of a crystalline complex of calcite and natrolite with a very little admixture of clayey material. The character of the thick selvage is somewhat different, as it consists of a soft yellow clay which becomes more compact as the central portion of the selvage is reached. This central portion is often hollow and lined with acicular crystals of natrolite and, in a few cases only, small crystals of calcite.

Scattered irregularly throughout the flow are vesicles which are lined with crystals of natrolite and apophyllite, though the latter is very scarce.

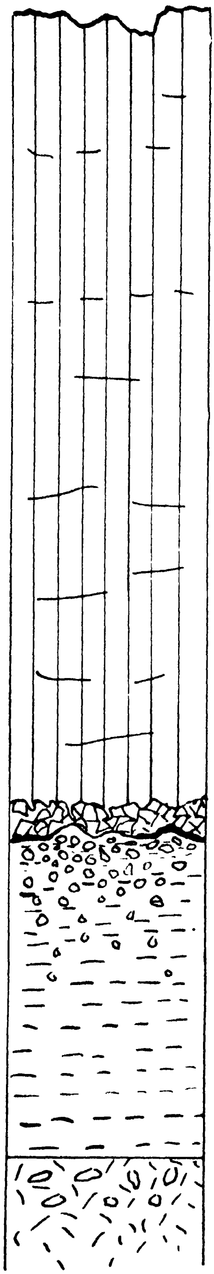

Fig. 1.

Vertical section through the basalt flows, Railway Quarry, Ardglen, New South Wales.

In the hand specimen the rock is very compact, with a dark bluish-grey colour, and here and there a phenocryst of glassy felspar. The fracture is sub-conchoidal. Under the microscope the rock is holocrystalline with fluidal fabric. The predominating mineral is andesine, which is lath-shaped and very fresh. Phenocrysts of labradorite are also present and are sometimes zoned. The augite consists of little grains filling the interstices between the felspar laths. A little perfectly fresh olivine and natrolite are present. Magnetite and apatite occur as accessory minerals.

The rock was analysed, giving the following result:—

		Norm.	
SiO_2	52.16		
Al_2O_3	17.58	Or	11.12
Fe_2O_3	3.37	Ab	35.63
FeO	5.23	An	23.35
MgO	4.97	Di	6.58
CaO	6.68	Hy	11.75
Na_2O	4.24	Ol	0.76
K_2O	1.95	Mt	4.87
H_2O —	0.43	Il	3.95
H_2O +	1.05	Ap	0.62
CO_2	nil	H_2O, etc.	1.49
TiO_2	2.14		
P_2O_5	0.36		
SO_3	abs	Magmatic name.—Andose.	
S	abs		
NiO & CoO	trace		
MnO	0.01		
CuO	abs		
	100.17		
Specific Gravity	2.719	Analyst, T.H.S.	

The Volcanic Breccia (Pl. xxvii, fig. 2): This lies immediately below the upper flow, the line of contact being very irregular but quite distinct. It consists of very coarse fragmentary material; individual fragments measure up to fifteen centimeters in diameter and consist of basalt and shale. The upper flow has intruded it in a number of places. The junction with the middle flow is irregular and in places marked by a thin band of carbonaceous shale, indicating that the middle flow had undergone considerable erosion and probably supported a luxuriant vegetation before the deposition of the breccia. The coarseness of the breccia and the fact that it contains fragments of basalt would seem to suggest that the volcanic centre from which it was ejected was at no great distance from the quarry.

In the breccia occur very irregularly shaped vughs conforming more or less to the shape of the fragmentary material. One of these vughs on being opened up was found to continue in a zig-zag course for about a metre, having a cross-sectional area of about three centimeters by eight centimeters. These vughs are occasionally filled or partly filled

with a banded amorphous material resembling chert in appearance. The dark bands in the illustration (Pl. xxviii) are a very dark drab colour and the lighter bands a light drab-grey. Occasionally there is present a thin white band composed of analcite. The cherty material has a smooth to subconchoidal fracture, is brittle, with a hardness of nearly 5, and effervesces with cold, dilute, hydrochloric acid. Under the microscope no crystalline structure is discernible except in the occasional bands of analcite. The material is by no means homogeneous in chemical composition and consequently an analysis of it is of no special value; for example, in three analyses the lime content varied as much as twelve per cent. A similar deposit has been recorded by Cross and Hillebrand[1] in the amygdules of the basalt of the Table Mountains, Golden, Colorado, U.S.A. The authors refer to the deposit as a stratified zeolitic material. It is interesting to note the presence of calcite, which is apparently in a very finely divided state. The sides of the vughs are always coated with a thin black lining. Under the microscope this lining is seen to be composed of a fibrous radiating mineral with straight extinction and a refractive index of about 1.60. It is colourless to dark brown. In addition there is a brown scaly mineral probably chalybite, which partially dissolves with effervescence in cold, dilute, hydrochloric acid, leaving a small residue of dark-coloured material insoluble in hot acid, as well as a little gelatinous silica. When the vugh is not completely filled with the banded amorphous material it is still coated with the black lining, on which analcite, calcite and natrolite have been deposited.

One very interesting specimen (Pl. xxix) obtained from the breccia consists of stalactites of black material, completely coated with analcite on which some crystals of calcite and tufts of acicular natrolite have been formed. The diameter of the stalactite including the analcite is about five millimeters, and the black core is about two millimeters in diameter. One of these stalactites was broken off, sectioned, and examined under the microscope. The black material was found to be identical with the lining of the vughs. The stalactites are composite, being made up of a number of columns of the fibrous radiating mineral with the brown scaly mineral occupying the interstices between the columns. A few small acicular crystals of natrolite have been deposited on these composite stalactites and are completely surrounded by analcite.

The Middle Flow (Pl. xxvii, fig. 2): This may be divided into two parts; whether they are really separate flows or two phases of the one flow it is difficult to say, for the central portion is covered by debris from the quarry. I am inclined to consider them as two phases of the one flow, the upper portion representing the more vesicular part and the lower portion the more solid part. The upper surface is quite irregular as mentioned above. The present thickness at the quarry averages about forty feet.

[1] Cross W. & Hillebrand W. F.—Bull U.S. Geol. Surv., 20, 1885, p. 14.

The upper portion is very vesicular and much decomposed; the vesicles are sometimes lined with diabantite, analcite, natrolite, calcite and chabazite, the last-named mineral being of very rare occurrence. There are two generations of calcite, the earlier colourless and the later stained reddish. In a number of cases the vesicles are completely filled with zeolitic and calcareous material, giving to the rock a general spotted appearance. On this account the quarrymen and local residents have applied the name "native cat" to the rock. Under the microscope the rock is seen to be much altered. The plagioclase, which is lath-shaped, has been completely zeolitised. The pyroxene, which is titaniferous augite, does not seem to have undergone such a complete change, though in places it has been altered to a green chloritic material. The olivine has been completely altered to scaly serpentine bordered by brown opaque hematite. In some cases, where the felspar has been entirely zeolitised, it is embedded in a fibrous, pale green, chloritic material, the fibres of which are at right angles to the surface of contact with the felspar. The rock is amygdaloidal, the amygdules, lined with chlorite, consist of either analcite or natrolite.

The lower portion of the flow is very much decomposed, often crumbling in the hand. It appears to be vesicular in places, but it is possible that these vesicles may represent spaces left by minerals that have been completely dissolved away. Occasionally a nodule of fairly fresh rock remains, and sections from these nodules show that the rock was an olivine basalt. The olivine is fairly fresh, but a little serpentine is developing along the cracks. The felspar is labradorite and lath-shaped; occasionally the centres of the laths have undergone some decomposition with the formation of a saussuritic mass. The augite is slightly pleochroic and when it occurs as phenocysts is idiomorphic. Both olivine and the plagioclase occur as phenocrysts and the groundmass consists of little plagioclase laths and granular augite with much iron oxide. A little apatite, biotite and devitrified glass are also present. The specific gravity of the rock is 2.937. Other material obtained from this portion of the flow had undergone considerable alteration. The felspar is completely zeolitised and the olivine altered to serpentine and hematite. The rock is porphyritic in felspar, augite and olivine. When the augite occurs as phenocrysts it has suffered very little alteration. The ground-mass consists of small laths of zeolitised felspar set in a brown glass containing a considerable amount of finely divided iron ores. A little analcite, natrolite and a pale green isotropic mineral are also present.

No specimens of zeolites were obtained from this portion of the flow.

The Lower Flow outcrops on the bed of the creek running below the quarry. The junction with the middle flow is fairly regular and horizontal over the short distance that it can be seen. The rock is similar to the "native cat" in appearance. Under the microscope the rock is seen to have undergone considerable alteration. In some cases the felspars have been zeolitised, though a number have escaped any

serious alteration. The pyroxene consists of little prisms and grains of titaniferous augite. The olivine has been completely altered to serpentine. Fluidal fabric is well developed and the rock is somewhat vesicular, the vesicles being lined with a pale green, fibrous, chloritic material and filled or partly filled with either analcite or natrolite.

The only zeolites obtained were natrolite, in stout white crystals, and colourless, well crystallised analcite.

Unfortunately the writer was unable to trace these flows to their source or obtain sufficient data to determine their geological age. On the geological map of New South Wales (1914) issued by the Geological Survey, they are marked as Tertiary. While this may be true of the upper flow I suggest that it is at least doubtful whether the lower flows belong to the same period; on the other hand, the deeply eroded surface and advanced state of decomposition of the middle flow, compared to the freshness of the upper flow, cannot be accepted as evidence of any great time gap between them. It was thought that a comparison of the chemical composition of the upper flow with that of other basalts in New South Wales might throw light on the age of the flow, but basalts of both Palaeozoic and Tertiary age were equally comparable in composition to this flow. In regard to the lower one, as stated above, only a very small outcrop was examined but on the evidence available it seems fairly certain that both lower and middle belong to the same period. The following crystallographic notes have been supplied by the Director, Dr. C. Anderson:—

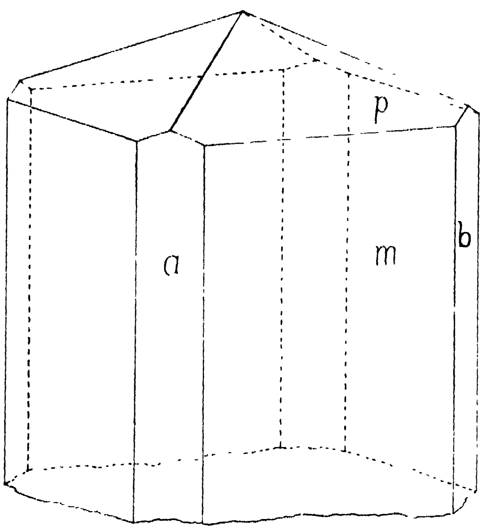

Fig. 2.

Natrolite, Ardglen, New South Wales. Forms a(100), b(010), m(110), p(111).

"*Natrolite* (Fig. 2) : The crystals are long prisms with the forms *a* (100), *b* (010) and *m* (110), *m* predominating, terminated by the form *p* (111). Other single planes giving very large indices are probably accidental impressions or contact planes resulting from the pressure of neighbouring natrolite crystals or crystals of analcite. As these planes generally give good signals it is probable that they are due to analcite. A further proof that these are not true faces is evidenced by the occurrence of frequent 'nicks' with perfectly smooth boundaries, in an otherwise good crystal.

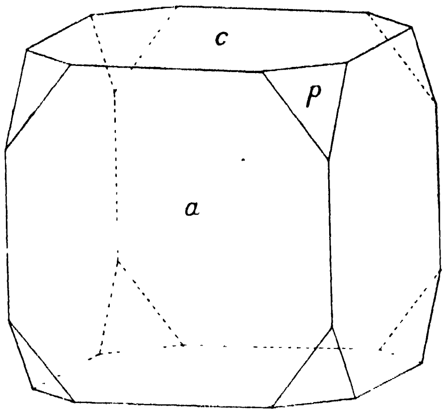

Fig. 3.

Apophyllite, Ardglen, New South Wales. Forms c(001), a(100), p(111).

"*Apophyllite* (Fig. 3) : The faces are wavy though brilliant and give distorted and multiple signals. The crystals are suspended among natrolite needles and are also penetrated by them. They are doubly terminated and the prisms are striated slightly parallel to the edge *a*:*c*. The forms *c*(001), *a*(010) and *p*(111) are present.

"*Analcite*: The only form present is the trapezohedron *n*(211), and in this it is similar to the analcite of Ben Lomond, New South Wales.

"*Chabazite*: Of the few crystals obtained none is suitable for measurement. However they were recognised as the variety phacolite, twinned on the vertical axis."

Calcite (T.H.S.) : The crystals deposited on the stalactites referred to above are doubly terminated and the only form present is the positive rhombohedron *M*(40$\bar{4}$1). Both generations of the calcite in the middle flow are more or less etched and are not measurable. They are not doubly terminated and are of scalenohedral (?) habit.

The distribution of the zeolites and calcite is shown in the table below:—

Mineral	Upper Flow	Breccia	Middle Flow	Lower Flow	Selvage
Natrolite	1. acicular	3. rad. tufts	4. rad. tufts	stout white	1. acicular & rad. tuft colourless
Apophyllite	2. colourless rare	......	.. ...	.. ...	......
Analcite	...	1. colourless	1. colourless	colourless	.. ...
Chabazite	.....	... ..	2. rare	... ..	......
Calcite	.. .	2. reddish	3. whitish 5. reddish large	... ..	2. massive

The numbers refer to the order of crystallisation in any one flow and are to be considered as only approximate; it is certain that in some cases there is an overlapping in the periods of growth. In the case of the lower flow no numbers are given because the order of crystallisation is not at all evident.

Paragenesis: The most significant fact about the upper flow is its freshness. The few vesicles that do occur are lined with comparatively large crystals of natrolite and apophyllite, while the crystals of natrolite and calcite occurring in the selvage material between the columns are quite small. If it be assumed that the natrolite and calcite of the selvage are derived from magmatic waters, then it is reasonable to expect that the vesicles in the basalt itself would contain calcite, or at least a calcium-bearing mineral in some quantity. But this is not the case, for, although apophyllite is present, it is the rare exception. The pale yellow clayey material in the selvage is undoubtedly decomposed basalt, and must be regarded as the result of the action of surface waters. The natrolite and calcite were deposited along with this clayey material, and, where the latter has not completely filled the crevices, crystals of natrolite have been deposited on it, and in some cases the clay has been indurated by the action of the solutions containing the zeolitic material. The upper surface of the flow has been much eroded, and its decomposition would be capable of supplying the selvage material. If this be the case, the action would be carried down to the breccia. This has occurred, for both natrolite and analcite are found there, but, in addition, there is present

analcite which has crystallised before either the natrolite or calcite. To return to the upper flow, unfortunately only one vesicle was examined *in situ* and there is no trace of the passage of ground waters either along crevices or through the rock; this applies to a number of specimens collected by workmen and others. The rock when examined under the microscope is particularly fresh. This raises the question of the origin of the analcite found in the breccia. Doelter[2] has pointed out that analcite crystallises between 180°C. and 440°C. and natrolite between 0°C. and 180°C. It is hard to conceive that the plane of critical temperature of ascending waters would exactly coincide with the uneven upper surface of the breccia. The analcite is never found in the selvage material, even where this extends right down to the breccia, but it is found in the underlying basalt. Tschermak[3] has shown that natrolite consists of $SiO_4H_4(Kn)$ and analcite of $Si_2O_6H_4(Kn)$, where $Kn = Si_2Al_2Na_2O_8$; that is to say that in the former case Kn is united with one molecule of orthosilicic acid and in the latter with one molecule of disilicic acid. From the nature of the case it is highly improbable that any interaction of the solution with the material of the breccia and the lower flow would be responsible for this change in composition. If we accept the theory of the cooling of a lava as indicated by the columnar structure advanced by A. V. G. James[4], the temperature of the upper flow would gradually decrease at a more or less uniform rate from its upper surface downwards, and at the time of crystallisation of the zeolites the temperature gradient could be such that natrolite would form in the vesicles of the flow and analcite in the tuff. It is to be regretted that the position of only one vesicle in the upper flow is known for certain. This was found in the higher level of the flow, but it seems doubtful whether any were found near the base. Obviously the problem of the paragenesis of the zeolites occurring in the middle flow is much more complex. From the data available it is impossible to say how much the middle flow has been affected by magmatic solutions accompanying the upper flow or by surface waters containing material in solution derived from it. The flow has certainly been affected by surface waters, but here and there nodules of rock have withstood this weathering. A study of these nodules reveals a widespread zeolitisation of the felspars although portions of the flow have not been subjected to such treatment. There appears to be no definite arrangement of such affected and unaffected portions.

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2 Doelter—Tscher. min. und petr. Mitt. xxv, 1906, pp. 79-112.

3 Tschermak—Sitz. Akad. Wiss, Wien, math.-nat. Kl. cxxvii, 2 & 3, 1918, p. 285.

4 James—Jour. Geol. xxviii, 5, July-August, 1920, pp. 458-469.

It is concluded therefore that the natrolite and apophyllite in the vesicles of the upper flow and the analcite of the breccia are primary and contemporaneous, that is they have crystallised from the same magmatic solutions, while the natrolite and calcite of the selvage and tuff are secondary, that is derived from the action of surface waters. The feldspar of the middle flow has been zeolitised by magmatic solution accompanying the extrusion, and zeolites have been deposited from this solution, but the action of surface waters with the deposition of zeolites has been so active and widespread that it is difficult to separate secondary and primary zeolites in the hand specimen. In the case of the lower flow not enough evidence has been collected to throw any light on the paragenesis of the zeolites.

My thanks are due to the Director, Dr. C. Anderson, M.A., Prof. W. R. Browne, D.Sc., and Mr. G. J. Burrows, B.Sc. for much valuable help.

EXPLANATION OF PLATE XIX.

Fig. 1. *Pinna isosceles* Hedley, type from Sydney.

" 2. *Pinna menkei* Reeve, from Camden Haven; exterior.

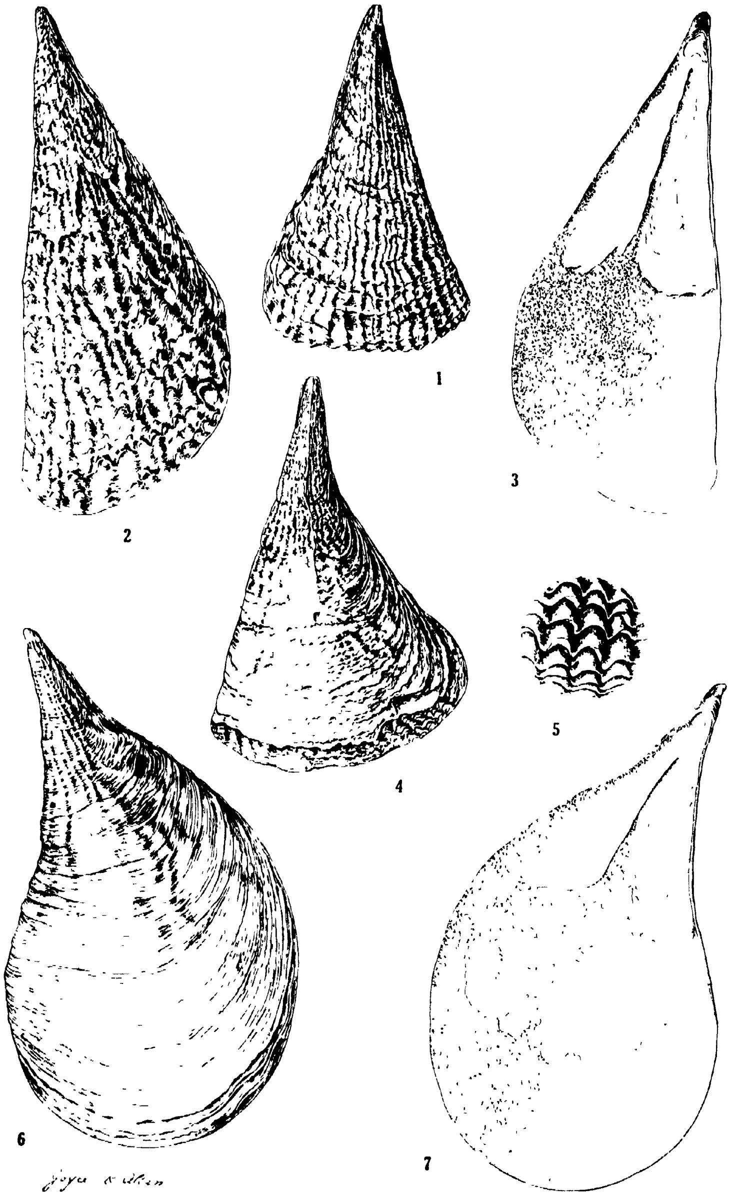
" 3. *Pinna menkei;* interior to show muscle scars.

" 4. *Pinna virgata* Menke, from South Australia.

" 5. *Pinna virgata;* sculpture enlarged.

" 6. *Pinna scapula* Hedley, type from Port Darwin; exterior.

" 7. *Pinna scapula;* interior.



1 2 3 4 5 6 7

JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XX.

Fig. 8. *Pinna menkei* Reeve, var. *caviterga* Hedley, type from Fraser Island, Queensland.

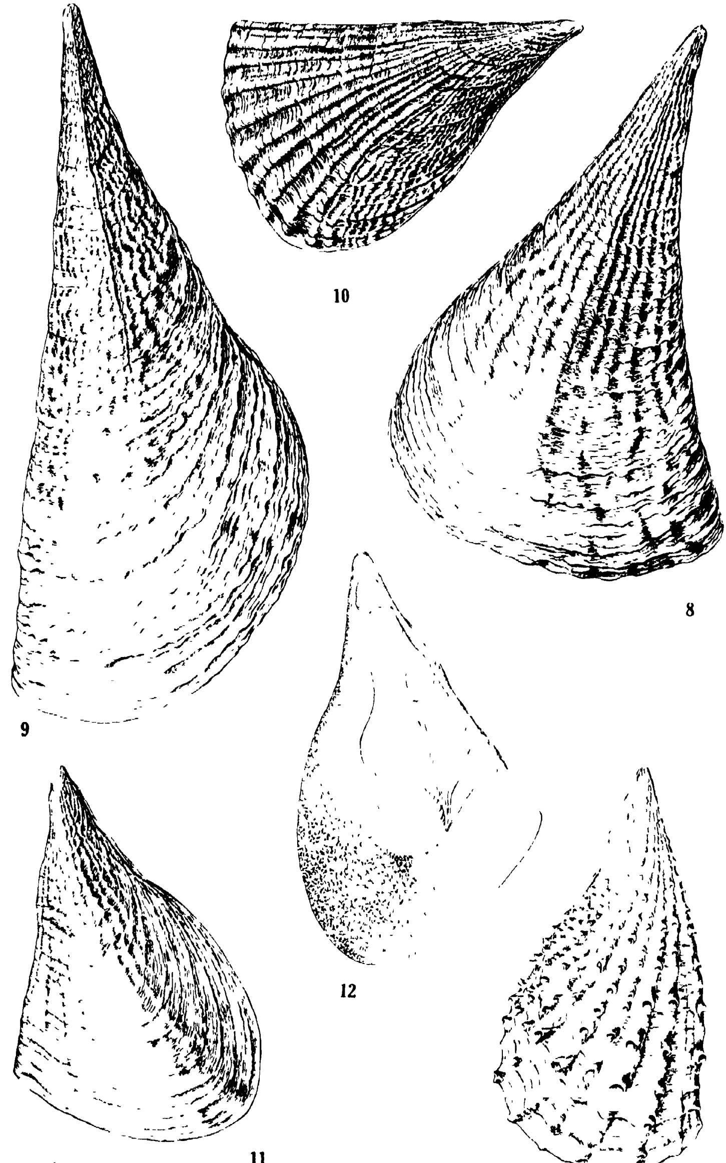
,, 9. *Pinna dolabrata* Lamarck, from Port Adelaide.

,, 10. *Atrina strangei* Reeve, from Norah Head.

,, 11. *Atrina gouldii* Reeve, from "Queensland"; exterior.

,, 12. *Atrina gouldii*; interior.

,, 13. *Atrina tasmanica* Tenison Woods, from Norah Head.



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JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XXI.

Fig. 14. *Pinna dolabrata* Lamarck, from a cotype in the Geneva Museum; exterior.

„ 15. *Pinna dolabrata;* interior. These were photographed for me and are now published by the kind permission of M. Bedot, Director of the Muséum d'Histoire Naturelle de Genève.

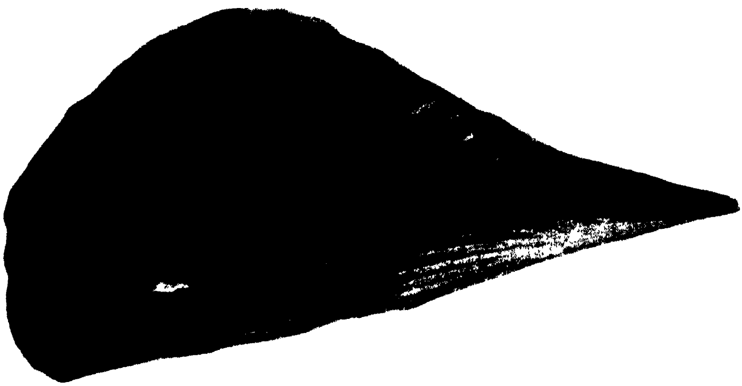


Fig. 14

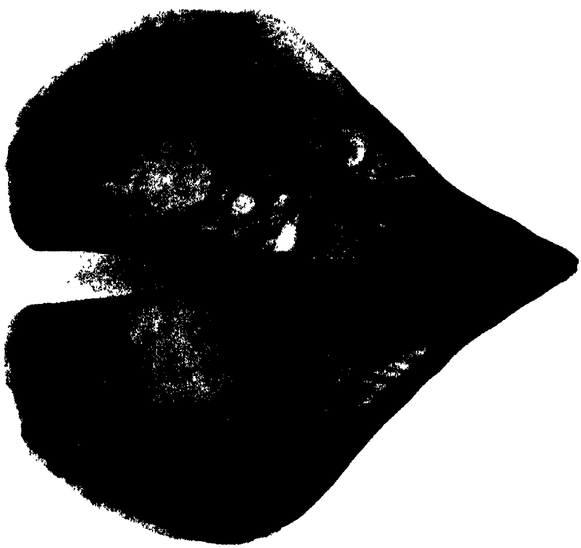


Fig. 15

EXPLANATION OF PLATE XXII.

Fig. 1. *Uber mammatum* Bolten.

,, 2. *Uber simiæ* Deshayes.

,, 3. *Uber apacum* Recluz.

,, 4. *Uber pyriforme* Recluz.

,, 5. *Uber mellosum* Hedley type.

,, 6. *Uber labyrintheum* Hedley type.

,, 7. *Uber sebæ* Recluz.

,, 8. *Uber citrinum* Philippi.

JOYCE K. ALLAN, del.

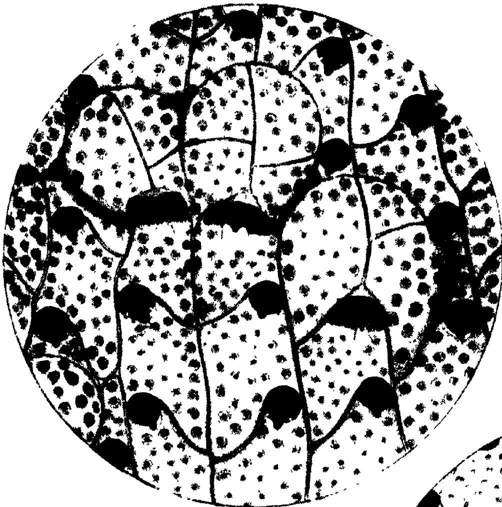
EXPLANATION OF PLATE XXIII.

Fig. 1. *Parmularia obliqua* MacGillivray. Ooecial detail of an incinerated portion of a colony taken from 3 to 4 miles off Eden, New South Wales, 25 to 30 fathoms.

,, 2. *Parmularia obliqua* MacGillivray. Section showing the common basal wall and communication pores, together with the basal walls of two ooecia. From a colony taken at the same locality as above.

,, 3. *Parmularia integer* Livingstone. The zooecial detail of the holotype.

N.B.—Figures other than photographs have been prepared with the aid of a camera lucida, and, as the same magnification was used throughout, the comparative size of zooecia of the different species will readily be seen.



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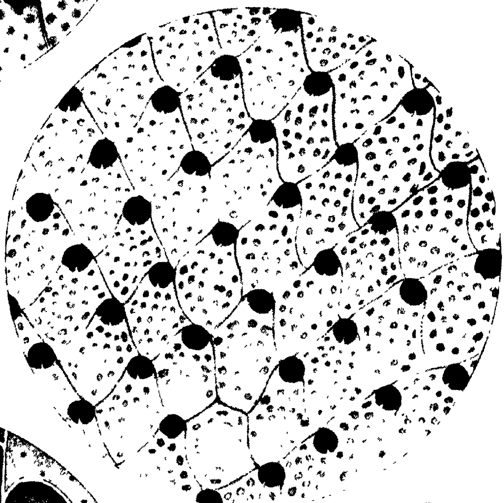

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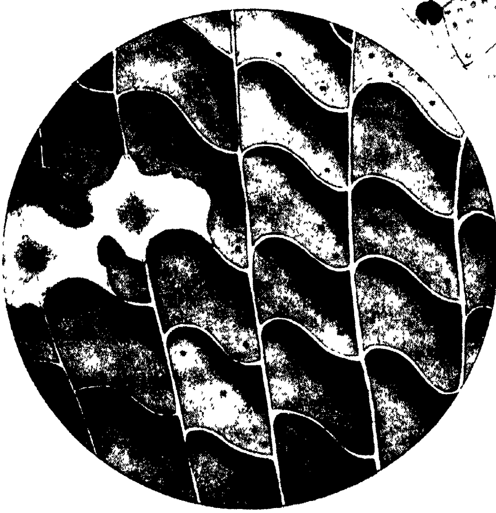

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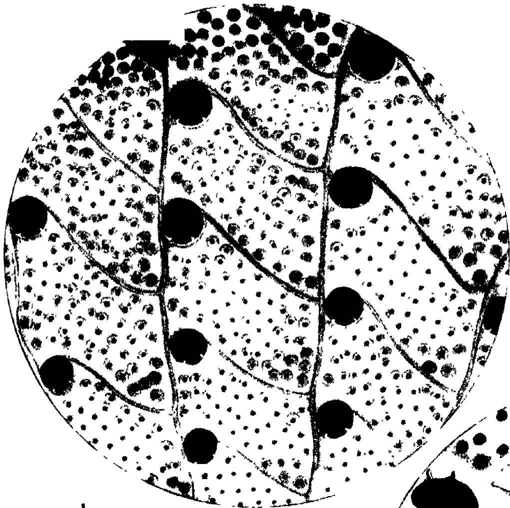
G. P. WHITLEY, del.

EXPLANATION OF PLATE XXIV.

Fig. 1. *Parmularia macneilli* Livingstone. The zooecial detail of the holotype.

„ 2. *Parmularia macneilli* Livingstone. The ooecial detail of the holotype.

„ 3. *Arachnopusia ajax* Livingstone. The zooecial detail of the holotype.



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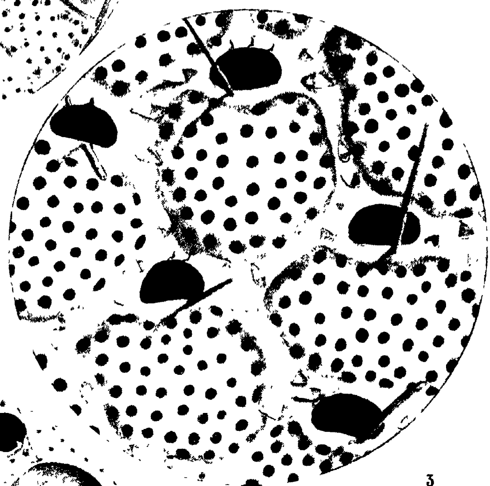

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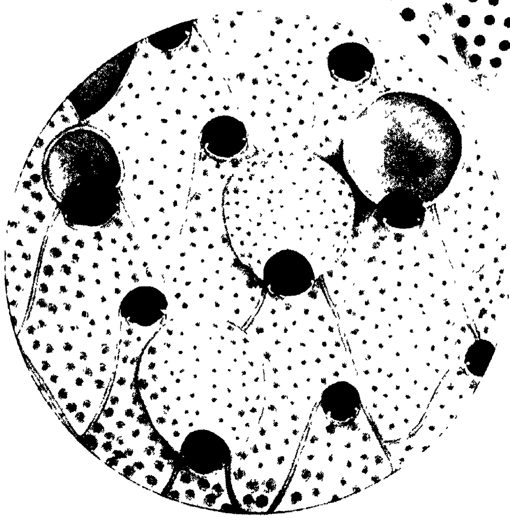

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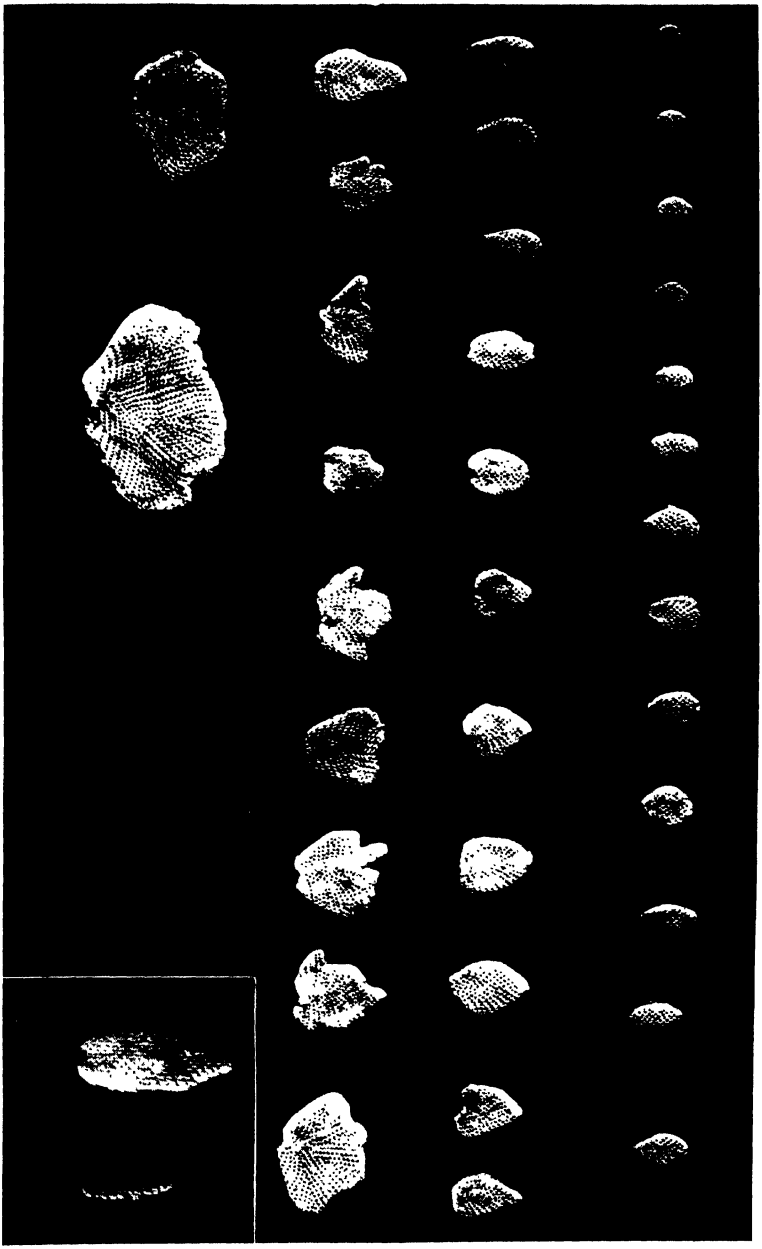
G. P. WHITLEY, del.

EXPLANATION OF PLATE XXV.

Parmularia obliqua. A series of complete colonies from Oyster Bay, Tasmania, 40 fathoms, illustrating the variation in size and growth, together with the development of the arched series of zooecia. The smallest specimen is 2.5 mm. long and 1.5 mm. wide, while the largest measures 19 mm. in length and 13 mm. in width. The fifth colony in the series is about the same size and shape as Maplestone's type of *S. flabellata.*

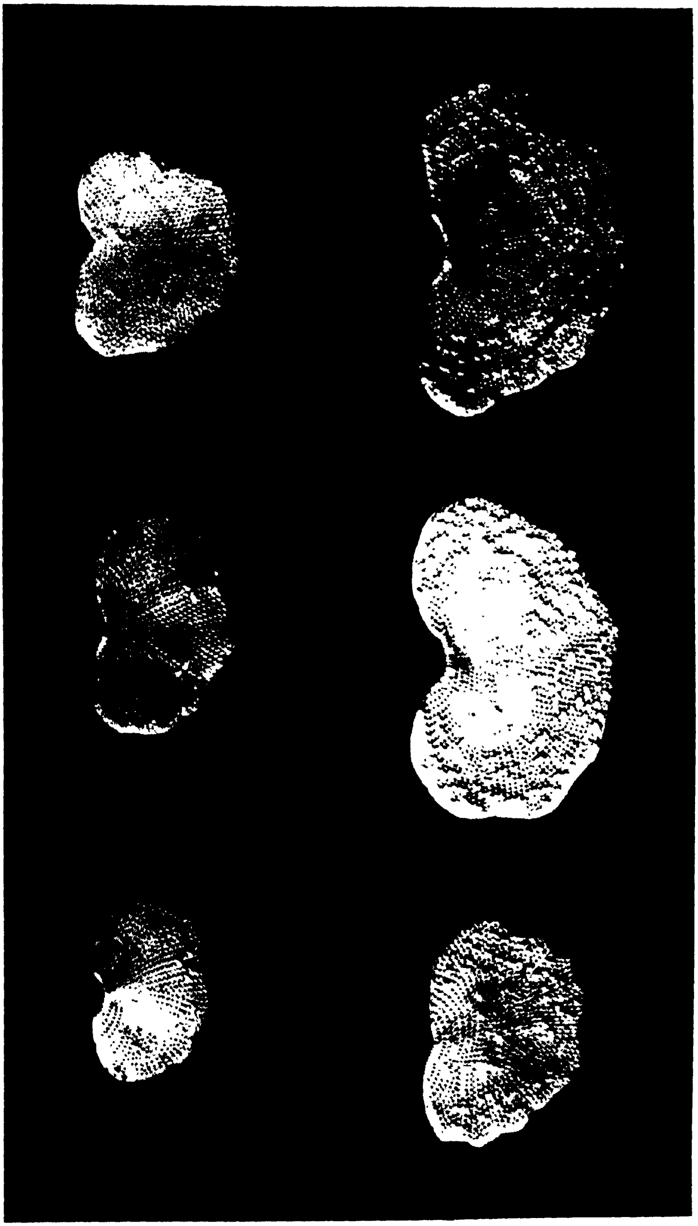
Inset.—*Parmularia macneilli* Livingstone. Showing the shape of the holotype colony together with a smaller paratype.



G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXVI.

Parmularia obliqua. A series of six large colonies from 3 to 4 miles off Eden, New South Wales, 25 to 30 fathoms, illustrating the fan or kidney shape of the typical adult form. These range in size from 15 mm. by 10 mm. to 28 mm. by 15 mm.

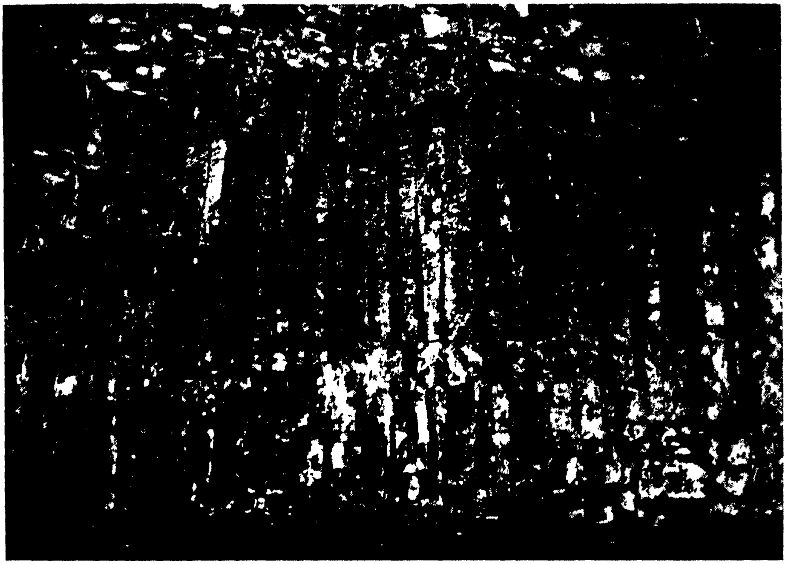


G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXVII.

Fig. 1. The upper flow, Railway Quarry, Ardglen, New South Wales, showing the columnar nature of the basalt.

Fig. 2. The volcanic tuff, Railway Quarry, Ardglen, New South Wales, showing the junction with the upper and middle flows.



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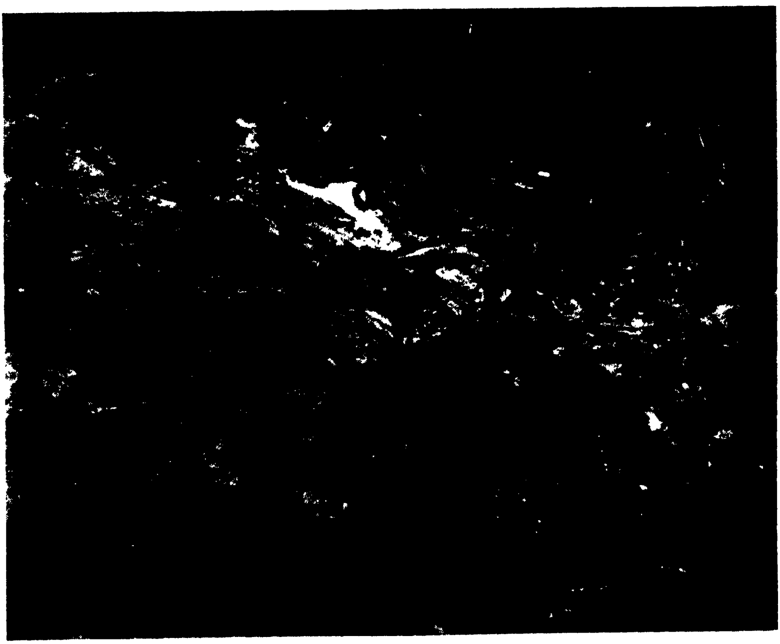

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C. ANDERSON, photo.

EXPLANATION OF PLATE XXVIII.

A vugh occurring in the volcanic tuff, Ardglen, New South Wales, partly filled with a banded amorphous material. The remaining portion of the vugh is coated with analcite, calcite and natrolite.

ANTHONY MUSGRAVE, photo.

EXPLANATION OF PLATE XXIX.

Stalactites occurring in a vugh in the volcanic tuff, Ardglen, New South Wales. These are coated with analcite on which some crystals of calcite and natrolite have been formed.

G. C. CLUTTON, photo.

NOTES ON THE EXTINCT CHELONIAN MEIOLANIA, WITH A RECORD OF A NEW OCCURRENCE.

By

C. Anderson, M.A., D.Sc.

(Plates xxx-xl, and one map.)

INTRODUCTION.

The somewhat complicated history of the genus *Meiolania* has been skilfully disentangled by Dr. Smith Woodward[1], so that a brief statement will suffice to bring our information up to date. It was originally discovered in the Pleistocene of the Darling Downs, Queensland, and described by Owen[2]; this species was subsequently called *Meiolania oweni* by Smith Woodward[3]. A second form from Lord Howe Island was described by Owen as *Meiolania platyceps*[4]. In 1889 R. Etheridge, Junior, recorded fragments consisting of a small horn core, part of a caudal vertebra, and segments of a tail sheath from the Canadian Lead, Gulgong, N.S. Wales (? Pliocene)[5], and again in 1893 the same author described as meiolanian two horn cores found in the superficial (Pleistocene) deposits of Coolah, N.S. Wales[6].

In 1898-99 the bony ring of a tail sheath, the skull and mandible, portion of a carapace, and other fragments of a similar animal were found in the Chubut beds of Patagonia, which are probably of Eocene age. These were described by Smith Woodward as *Miolania argentina*[7], and the author discussed the significance of its distribution, suggesting that, as *Meiolania* was undoubtedly a terrestrial or marsh chelonian, its occurrence in Patagonia and the Australian region offers support to the hypothesis of a former land connection between South America and Australia by way of the Antarctic. He considered it just possible, however, that "if the direct ancestors of *Miolania* were known, this remarkable chelonian would prove to have originated not on any old Antarctic continent, but in some other region of the globe, from which scattered survivors wandered into the lands now named South America and Australia, respectively."

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1 Smith Woodward—Ann. Mag. Nat. Hist., (6), i, 1888, pp 85-89.
2 Owen—Phil. Trans., clxxi, 1880 (1881), pp. 1037-1050.
3 Smith Woodward—Loc. cit., p. 89.
4 Owen—Phil. Trans., clxxvii, 1886 (1887), pp. 471-480.
5 Etheridge Jr.—Rec. Geol. Surv. N.S. Wales, i, 1889, pp. 149-152.
6 Etheridge Jr.—Rec. Austr. Museum, ii, 1893, pp. 39-41.
7 Smith Woodward—Proc. Zool. Soc., 1901, i, pp. 170-176, 182-183.

Dollo[8] regards the peculiar distribution of *Meiolania* as strong evidence of a former Antarctic connection between South America and Australia, but Tate Regan[9] combats this view, and also suggests that the Patagonian form, which is so much the older, belongs to a distinct genus *Niolamia*, as proposed by Ameghino[10].

Reference may also be made to Huxley's paper[11], in which he regarded *Meiolania* as a crytodire allied to the chelydroids. This was controverted by Boulenger[12], who classes it as a pleurodire, in opposition to Baur[13], who advanced arguments for regarding it as a cryptodire resembling the Testudinidae.

To sum up, we have evidence of the former existence of a peculiar chelonian family, remains of which have been preserved in Patagonian beds of probable Eocene age, in the Pliocene (?), and Pleistocene of N.S. Wales, the Pleistocene of Queensland, and the Pleistocene or Post-Pleistocene of Lord Howe Island. Some authors recognise only one genus, others two, while Huxley and Baur regarded it as cryptodiran, and Boulenger and Smith Woodward classed it with the Pleurodires.

To the localities enumerated above must now be added another, namely Walpole Island, about one hundred miles south-east of New Caledonia, where fragmentary bones, closely resembling those of the Lord Howe Island form, *Meiolania platyceps*, have recently been found by Mr. A. C. Mackay, engineer to the Australian Guano Company, and generously presented by him to the Australian Museum. This form I describe in this paper as *Meiolania mackayi*, in honour of the discoverer.

On comparison of the Walpole Island fossil with the material from Lord Howe Island, it was found that the Museum contains a large series of the latter, some of it undescribed and of considerable interest, so that the opportunity has been taken to add something to our knowledge of *Meiolania platyceps*. At the same time, a restoration of its skull has been prepared, under my direction, by Mr. J. Kingsley, Assistant Articulator, a work which he has performed with great skill. This restoration has been rendered possible by the generous loan of specimens preserved in the collection of the Department of Mines, N.S. Wales, including the two fine skulls described by Owen[14].

8 Dollo—Résultats du Voyage du S.Y. Belgica; Poissons, 1904, pp. 222-224.

9 Tate Regan—Rept. Brit. Antarctic ("Terra Nova") Expedition, Zoology, i, 1 (Fishes), 1914, pp. 43-45.

10 Ameghino—Sinopsis Geologico-Palaeontologica, Suplem. (1899), p. 10 (quoted by Smith Woodward, loc. cit, p. 170).

11 Huxley—Proc. Roy. Soc., xlii, 1887, pp. 232-238.

12 Boulenger—Proc. Zool. Soc., 1887, pp. 554-555; Ann. Mag. Nat. Hist. (6), iii, 1889, pp. 138-141.

13 Baur—Ann. Mag. Nat. Hist. (6), iii, 1889, pp. 54-62.

14 Owen—Phil. Trans., clxxix, 1888 (1889), B, pp. 181 184, pls. xxxi-xxxiv.

For the loan of these and other specimens I am indebted to Mr. R. H. Cambage, formerly Under Secretary for Mines, Mr. E. C. Andrews, Government Geologist, and Mr. G. W. Card, Curator of the Mining Museum.

MEIOLANIA PLATYCEPS *Owen.*

Meiolania platyceps Owen, Proc. Roy. Soc., xl, 1886, pp. 315-316; Phil. Trans., clxxvii, 1886 (1887), pp. 471-480.

Meiolania minor Owen, loc. cit.

Ceratochelys sthenurus Huxley, Proc. Roy. Soc., xlii, 1887, pp. 232-238.

Meiolania platyceps (Owen) Smith Woodward, Ann. Mag. Nat. Hist., (6), i, 1888, p. 87.

Miolania platyceps Lydekker, Brit. Museum Cat. Foss. Rept. iii, 1889, pp. 160-166.

Owen's two species have been regarded as synonymous by subsequent authors, and that view is adopted here, although there are certain differences in individual skulls, and the large cranial horn cores vary considerably in size and shape.

Occurrence.

Lord Howe Island is situated 300 miles east of Port Macquarie, N.S. Wales, and is about seven miles long, with an average breadth of approximately one mile. It consists practically of but two geological formations, a basaltic series forming about two-thirds of the island, and a thin-bedded calcareous deposit composed of coral sand, covering the lower ground and flanking the three isolated volcanic masses, which at the south end attain a height in Mt. Gower of 2,840 ft. This coral-sand rock consists of comminuted and completely rounded coral debris, with grains of volcanic material, such as augite, magnetite, and altered lava, with occasional fragments of echinoderms, shells, foraminifera, and other invertebrates. Speaking generally, the constituents of the coral-sand rock agree very closely with the component particles of the present beach at Lord Howe Island. It varies in thickness, its greatest elevation being about 250 feet above sea-level[15]. It is in this coral-sand rock that the *Meiolania* remains have been found at various times since about 1880. My colleague, Mr. A. R. McCulloch, who has an intimate knowledge of the island, has kindly supplied me with notes on the occurrence of *Meiolania*, the results of his own observations and those of several residents who have been closely associated with the various finds.

[15] Etheridge Jr.—Lord Howe Island: Australian Museum Memoirs, No. 2, 1887, pp. 115-116, 119.

On the accompanying map, Mr. McCulloch has marked the areas where *Meiolania* bones have been discovered. It will be seen that they are restricted to two small patches close to the beach, on each side of the north end of the island.

"They are usually deeply embedded in the coral-sand rock, which in the area marked rises from below sea-level to a height of about eighty feet, where the basaltic spur on which it lies is exposed. Because of rock fractures and the crude methods usually adopted in extracting such portions as are detected, the bones secured are largely fragmentary. Disintegration of the rock, as a result of water action, accounts for the fact that outstanding portions of bones have been most commonly found in "runs" or creek beds, but, as the bones are found equally plentifully in neighbouring rock excavated during gardening operations, it is reasonable to suppose that they are fairly evenly disposed throughout much of the rock in the area marked on the map. Other bones, particularly horn cores, are frequently found lying loose in rich patches of loamy soil, which consists of decomposed basalt, coral sand, and decayed vegetable matter. These have undoubtedly become detached from the coral-sand rock during the process of disintegration."

"There is every reason to suppose that the coral-sand rock, which may be loosely coherent or firm and solid, is of aeolian formation, as noted by Etheridge[16]. Shells of the large land snail *Placostylus* are commonly found in the rock, together with bones and eggs of the burrowing Mutton Bird (*Puffinis*); fragments of marine shells are exceptional, and only such as might be expected to occur on any coral-sand bank, whither they have probably been carried by birds. The coral-sand rock in which *Meiolania* bones occur has evidently been formed above sea-level, its consolidation being due to percolating fresh water. If this be correct, and it seems probable, the *Meiolania* bones found must be those of individuals which crawled out of the sea on to an old coral-send bank, probably to lay their eggs. Various accidents, such as rolling over a bank on to their backs, caused the death of many, just as happens to-day on Raine Island and Bramble Cay, Queensland, and other nesting places of the Green Turtle, *Chelonia midas*. Their bones were doubtless disturbed by birds, which pecked at the decaying flesh, and even more so by others of their own kind, which later scrambled laboriously over the sand to excavate huge pits for the accommodation of their nests of eggs. It was evidently by such means as these that the bones now found were scattered before becoming embedded in the coral-sand rock, into which the sand bank was later transformed. It is almost certain that all loose bones found have been liberated by the disintegration of the ancient coral-sand formation in which they were originally embedded."

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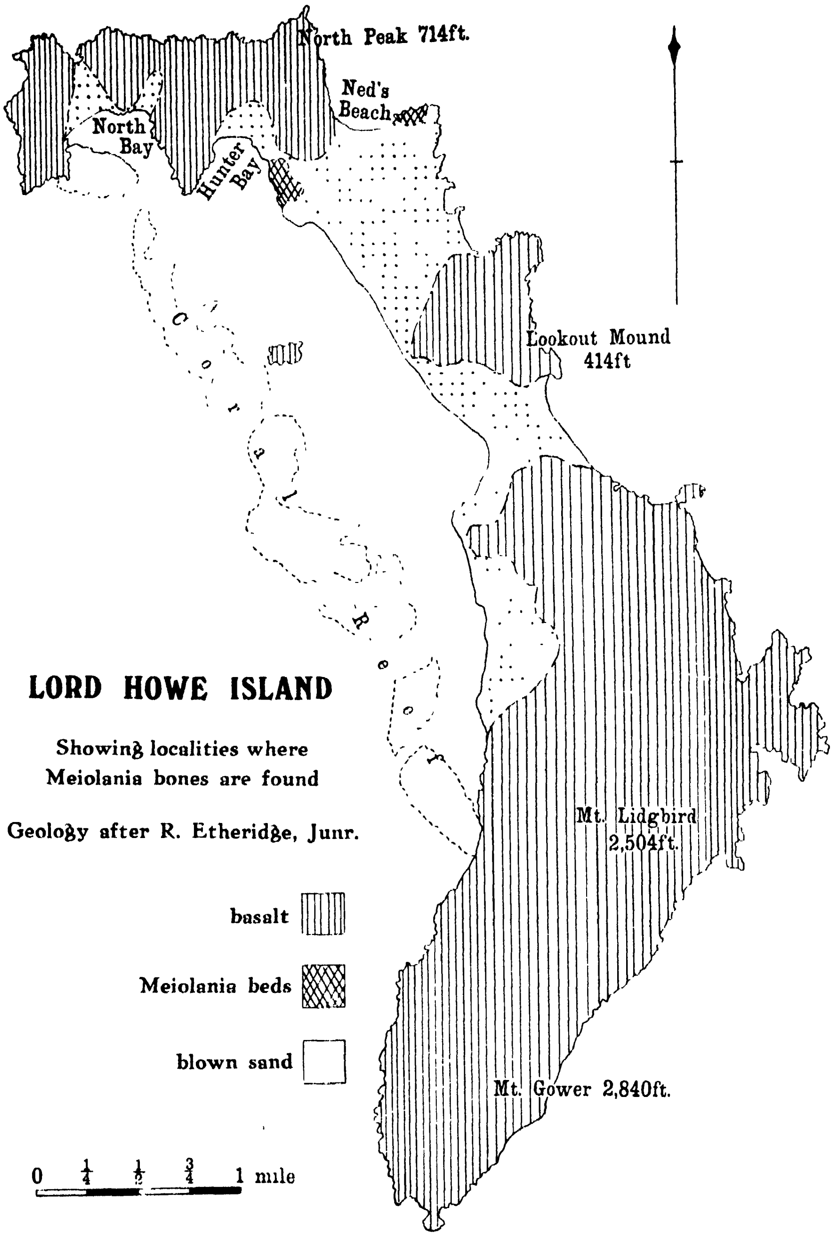
[16] Etheridge Jr.—Loc. cit., pp. 124-126.


North Peak 714ft.
Ned's Beach
North Bay
Hunter Bay
Coral Reef
Lookout Mound 414ft
LORD HOWE ISLAND
Showing localities where Meiolania bones are found
Geology after R. Etheridge, Junr.
basalt
Meiolania beds
blown sand
Mt. Lidgbird 2,504ft.
Mt. Gower 2,840ft.
0 1/4 1/2 3/4 1 mile

Mr. McCulloch's account of the mode of occurrence is very suggestive, and would point to the belief that *Meiolania platyceps* was marine in habitat, coming ashore only to lay its eggs, of which several have been found in association with the bones. If it be the case that the bones occur only in the two small areas shown on the map, this inference is greatly strengthened, for, were *Meiolania* a land chelonian, we should expect to find its remains fairly generally distributed over the island, except in the elevated portions. It is possible, however, that the fossil is restricted to a definite horizon low down in the coral-sand series, and that this bed has been exposed only at these two spots.

It is exceedingly unfortunate that the bones are not found in association, for, with very few exceptions, it is impossible to say that any two bones are parts of the same skeleton, so that we are left more or less in the dark as to the proportions of the animal. Another difficulty is presented by the tenacity with which the matrix adheres to the bones. It was observed, however, that where these have been buried in soil the matrix had been completely removed, evidently by the slow action of organic acids. This observation suggested the use of dilute acetic acid for the same purpose, and the results were very satisfactory, as will be seen later.

Shell.

Carapace.—Little is known of the carapace of *Meiolania platyceps,* for only fragments have been found. What have been regarded as marginal bones are in fair abundance; these are stout and wedge-shaped, and Lydekker, from material in the British Museum, was able to say that the margin of the carapace was strongly serrated[17]. These stout bones were evidently from the region before and behind the bridge, for the bridge peripherals found attached to the plastron described below (Pl. xxx, fig. 1, *marg.*), are thin bones, consisting of two faces meeting at a very obtuse angle, with a feebly developed lateral carina. Portions of three associated dorsal vertebrae are preserved in the Australian Museum collection, and patches of the carapace are still in place; the bone is very thin, being about two millimetres in thickness.

Plastron (Pl. xxx, figs. 1, 2).—One of the most instructive specimens in the collection is a large portion of a plastron, to which were attached a nearly complete shoulder girdle and pelvis and two cervical vertebrae. The dorsal (inner) surface of the plastron was overlain by a thick layer of coral sand, which was removed and the girdles and vertebrae freed. The important discovery was made that the pelvis was not suturally attached to the plastron, indicating that *Meiolania* was not a pleurodire. It was lying almost, if not quite, in its natural position, and a distinct thin layer of the matrix intervened between it and the plastron. The girdles and vertebrae are described below.

[17] Lydekker—Brit. Mus. Cat. Foss. Rept., iii, 1889, pp. 164-5.

When the matrix was removed it was found that towards its centre the plastron becomes very thin, and the median portion is occupied by matrix only; in all probability there was a large median fontanelle with a digitate margin. The xiphiplastra are connected by digitations, and on the anterior lobe, which is imperfect, there is a digitate suture, apparently between the epi- and entoplastra. The bridge is of medium length, and is united to the marginals by digitate processes. The plastron is about 40 cm. wide, including the bridge, and about 50 cm. long. The bridge measures 18 cm. in fore and aft direction. There are no buttresses. The anterior and posterior lobes are very similar in shape and proportions.

The collection also contains a pair of plastral lobes, which may belong to one and the same individual, for they correspond in size. Both are much fractured and have been previously mended. On the posterior lobe there are two small symmetrically placed elevations, or tubercles, near the places where the pubes would come in contact with the plastron. As there is no evidence of the occurrence of any other chelonian than *Meiolania* in the coral-sand rock of Lord Howe Island, it is practically certain that these lobes are meiolanian. Probably these tubercles were for ligamentous attachment of pelvis to plastron. Possibly the plastron figured in Pl. xxx is that of a younger animal, the juvenile *Meiolania* having a pelvic structure of a cryptodiran type, while in the adult an approximation was made to the pleurodiran modification, as suggested by Lydekker for *Pleurosternon*[18].

Skull.

No complete skull has yet been discovered, and its structure must be deduced by piecing together the evidence afforded by several more or less satisfactory specimens; its main features have been well described by Owen. The almost total absence of sutures, and the difficulty of removing the adherent matrix, have proved serious handicaps to a complete understanding of the cranial structure. By the prolonged use of dilute acetic acid, I have, however, succeeded in removing the calcareous matrix from several skull fragments without injuring the bone, and not only made possible a fairly detailed study of the cranial foramina, but also revealed certain unsuspected sutures. I have therefore been able to supplement, and in some respects correct previous descriptions.

The front portion of the skull, shown in Pl. xxxi, is splendidly preserved, though as usual no sutures can be traced. This specimen had evidently been washed out of the coral-sand matrix and buried for some considerable time in soil, for it shows no trace of calcareous matrix, and the cavities were filled with soft black earth. We see that the nostrils were separated by a narrow vertical bar of bone, recessed somewhat from the front. On the lateral margin of each nostril a process curves downwards and inwards towards the median

18 Lydekker—Quart. Journ. Geol. Soc., xlv, 1889, p. 517.

bony partition. Leading from the nasal opening a pocket extends backwards and outwards into each maxilla (Pl. xxxii, fig. 1; Pl. xxxvi, fig. 1, *mx.p.*); the significance of this structure is unknown to me. The palatal view reveals that the choanae were situated well forward. Part of the triturating surface of the upper jaw is preserved, showing a low serrated ridge, running roughly parallel to the descending alveolar plate, and a deep pit for reception of the mandibular beak; the rest of the palate is missing. A foramen (*f. inc.*) on each side of the middle line, apparently near the junction of the premaxilla with the vomer, is the *foramen incisivum*, absent in Chelonidae and *Dermochelys*, but present in other recent genera, and particularly prominent in the Testudinidae.

A fragment of the left side of the skull roof (Pl. xxxii, fig. 1), extending from the external nostril to the temporal fossa, throws some light on the structure of this part of the cranium. A wide and deep *sulcus olfactorius* (*sulc. olf.*) is separated from the orbital region by a prominent ridge, *crista orbito-sphenoidea* (*cr. orb. sp.*), the lower edge of which curves inwards in places as if to convert the *sulcus olfactorius* into a tube; the same feature is present to some extent in *Testudo*. In this figure the maxillary pocket (*mx. p.*) is well seen.

Portion of the posterior region of a skull (Pl. xxxii, fig. 2), carrying a pair of short horn cores, shows a series of ridges, which indicate the boundaries of epidermal shields. In some places these ridges have a slight groove along their apex, as if formed by the coming together of the upturned edges of two bony plates. In recent chelonians, on the contrary, the edges of the shields are marked by sulci on the surface of the underlying bony plates. Similar ridges are very clearly shown on two fine cranial horn cores, which evidently belonged to one and the same individual (Pl. xxxii, figs. 3, 4). In fig. 4 is seen the rim of the tympanic fossa (*ty. foss.*) and portion of the deeply recessed quadrate. Careful inspection of various skull fragments led to the recognition of several ridges of the same kind, and the pattern thus formed is shown in the restored model figured in Pl. xxxvi.

The occipital fragment (Pl. xxxiii, fig. 1) is of exceptional interest, for it shows fairly distinctly the suture between basi- and exoccipital, and the junction of basisphenoid and basioccipital. Evidently the pterygoids slightly overlapped the junction of basisphenoid and basioccipital, completely cutting off the former from the under surface of the skull. The skull portion figured in Pl. xxxiii, figs. 2-4; Pl. xxxiv, figs. 1, 2, consists of nearly complete occipital and otic regions, with most of the brain case and portion of the pterygoids, besides part of the outer wall of the skull and two large horn cores curving upwards and backwards. That the cranial horn cores varied considerably in size and shape may be seen by comparing this specimen with that shown in Pl. xxxii, fig. 2; whether this is explicable as due to age or sex difference, individual variation, or indicates distinct

species, are questions which I am unable to answer. This specimen was largely cleared of matrix, separated into various portions along previously mended fractures, and studied in detail.

Viewed from the under side (Pl. xxxiii, fig. 2) the occipital condyle (*cond.*) is seen to be a fairly large, strong bone, slightly concave underneath. The suture between basioccipital and pterygoid is clearly indicated, and evidently the basisphenoid does not appear at all on the base of the skull. A curious feature is the transverse intra-pterygoid slit (*d*) which divides the bone into lower and upper lamellae. The lower lamella (upper in figure) bridges over a vacuity which Owen mistook for the posterior nares. Laterally the pterygoid extends back- and upwards, wrapping round the exoccipital. This backward prolongation of the pterygoid would indicate that *Meiolania* did not belong to the Pleurodira, in which the shortening of the pterygoid behind so that the quadrate comes into contact with the basi-cranial bones is one of the most characteristic features. The suture between the two halves of the pterygoid is indistinctly seen on the posterior part of the bone; in front it develops a median keel. When this skull fragment is viewed from the front (Pl. xxxiii, fig. 3; Pl. xxxiv, fig. 1), several important features may be observed. The anterior end of the basisphenoid falls steeply to the pterygoid, as in *Dermochelys*. The clinoid processes are feebly indicated, and just below them on the front of the basisphenoid are two foramina (*abd. c*), probably exits for the abducent nerve. Near the middle line on each side, just above the junction of basisphenoid and pterygoid, are the anterior openings of the carotid canal (*car. c.*). Lateral to these is a bony bridge (*e*) connecting the pterygoid with the parietal region and the front of the brain case. This may be the descending parietal plate found in all recent chelonians, except *Dermochelys*, or it may be the epipterygoid, or perhaps it represents both, the lateral ridge being the epipterygoid, which is fused to the descending plate of the parietal. This bony bridge spans a large opening (*c. cav.*), the anterior end of the *canalis cavernosus*, or jugular canal. There are indications of a rostral process to the basisphenoid, but this has not been preserved in any of the specimens.

The tympanic region is shown in Pl. xxxiii, fig. 4, and it will be observed that the quadrato-otic mass is swollen and deeply hollowed, forming a large tympanic chamber with very thin walls. The open stapedial fissure is narrowly bridged over near the side wall of the skull, the *columella auris* gaining access to the *fenestra ovalis* through a pear-shaped opening (*f*). In this respect *Meiolania* resembles the pleurodires, as also in the concomitant closure of the tympanic fossa behind by encircling bone. This latter feature is regarded by Boulenger as evidence of its pleurodiran affinities[19], but Baur attributes it solely to dermal ossification[20].

[19] Boulenger—Proc. Zool. Soc., 1887, pp. 554; Ann. Mag. Nat. Hist., (6), iii, 1889, p. 139.

[20] Baur—Ann. Mag. Nat. Hist., (6), iii., 1889, p. 56.

Cranial cavity.—Several specimens showing the greater part of the brain case (except the roof) are in the collection, and these were carefully cleared of matrix by acetic acid alone. The process was very successful, the foramina and various passages being revealed throughout their length, and the bony labyrinth laid bare so that it could be examined just as in a recent skull.

The cranial floor is tunnelled longitudinally by a pair of canals (*g*), beginning about the middle and emerging some little distance behind the anterior margin of the basisphenoid (Pl. xxxiii, fig. 5). A little in front and lateral to their point of emergence is another pair of foramina (*abd. c.*), which tunnel the front of the brain case downwards and forwards to emerge on the anterior face of the basisphenoid; these are the supposed abducent canals previously referred to. In this specimen there are three interior openings for the hypoglossal nerve (*hy. c.*).

A similar specimen (Pl. xxxiii, fig. 6) is drawn so as to show the side wall of the cranial cavity. Here the floor in front has been removed to show that a plate of bone forms a sort of false bottom, underneath which run the two longitudinal canals referred to previously (Pl. xxxiii, fig. 5, *g*). The walls of the brain cavity are well ossified, there being no *hiatus acustica* between prootic and opisthotic, as in recent forms, or the merest indication of this feature in an oblique crescentic groove in the upper (posterior) end of which a canal pierces the side wall to enter the auditory chamber. The obliquely placed crescentic *foramen jugulare anterius* (Siebenrock[21]), vago-accessory foramen (Kesteven[22]), bounds the medial wall of the auditory chamber behind (*f. jug. ant.*). This wall is slightly convex medially, and is pierced by three foramina leading into the auditory chamber. Two of these foramina are situated in the bottom of a small pit at the anterior end of a smooth groove which runs forward from the lower edge of the *foramen jugulare anterius* in the angle between the side wall of the brain case and its floor. This pit (*int. aud. me.*) is evidently the *meatus auditorius* (Siebenrock, p. 270), *meatus acusticus internus* (Kesteven, p. 393), *fossa acustico-facialis* (Nick[23]), which in recent forms contains the foramina for the facial and acustic nerves.

Looking into the *fenestra postotica* (Nick, p. 23) of the right side obliquely forwards and inwards (Pl. xxxv, fig. 1), we see near the posterior wall a recess, in the upper part of which is the *foramen jugulare*. This is somewhat constricted, roughly oval in shape, and is separated from the auditory chamber containing the bony labyrinth by a thin wall (evidently part of the opisthotic), which is pierced in its lower half by a nearly round opening (*k*), leading into the auditory

[21] Siebenrock—Sitz. d. k. Akad. Wiss. Wien, Math. Naturw. Cl., cvi, 1, 1897, p. 252.

[22] Kesteven—Journ. Roy. Soc. N.S. Wales, xliv, 1910, p. 392.

[23] Nick—Zool. Jahrb. Anat. Ontog., xxxiii., 1, 1912, p. 31.

chamber. The *foramen jugulare posterius* is, as in *Chelonia midas* and *Dermochelys,* not enclosed by bone. The *fenestra ovalis* (*fen. ov.*) is nearly circular, and, before the matrix was removed, it was partially blocked by the inner end of the *columella auris.* This had the usual shape of a circular piece of bone, concave to the auditory chamber, with indications of a slender stalk on its outer surface, the beginning of the medio-stapedial. The auditory chamber and bony labyrinth are described in detail below. The lower lateral half of the *fenestra postotica* is occupied by a large, elongated, somewhat boomerang-shaped opening (*c. cav.*), the jugular sinus or posterior opening of the *canalis cavernosus* (Nick, p. 30), which opens on the front of the otic mass between the descending parietal plate and the basisphenoid (Pl. xxxiii, fig. 3; Pl. xxxiv, fig. 1). The bony septum between the *fenestra ovalis* and the jugular sinus is pierced near its median inferior end by the posterior opening of the carotid or pterygoidal canal (*car. c.*), which runs obliquely forward to open near the median line, just in front of the brain case (Pl. xxxiii, fig. 3; Pl. xxiv, fig. 1); close to the anterior wall bounding the *fenestra ovalis,* is the lower end of the carotico-temporal canal (Siebenrock, p. 289), *canalis anteriae facialis* (Nick, p. 27), which runs a short course upwards to open into the temporal fossa (Pl. xxxiii, fig. 5; Pl. xxxv, fig. 1; *car. temp. c.*).

Auditory chamber.—This is the name I have used for the cavity lying between the *fenestra ovalis* and the side wall of the brain case. Viewed obliquely from the post-otic fenestra (Pl. xxxv, fig. 1), this cavity is seen to form a fairly roomy chamber. The medial wall, as previously mentioned, is complete, except for small openings serving for the passage of nerves and blood vessels. The posterior wall, as stated above, has an opening (*k*) communicating with the vago-accessory canal. In the roof of the chamber is a nearly circular opening, the canal commissure (*c. com.*) for the common limb of the anterior and posterior semicircular canals. In the upper part of the posterior wall is a recess, the opisthotic vestibular recess (Pl. xxxiv, fig. 2, *m*) for the reception of the ampullae of the posterior and the exterior (horizontal) semicircular canals. The corresponding anterior vestibular recess in the prootic is smaller. The orifices of the two vertical semicircular canals are situated in these recesses. The course of the anterior and posterior canals (*c.s. ant.* and *c.s. post.*) was revealed by cutting away the bone from above (Pl. xxxiii, fig. 5). They lie in a groove, forming a semicircle, its convexity medial. At each end of the groove is an orifice communicating with the anterior and posterior vestibular recesses, and in the middle the large opening (*c. comm.*) for the common limb of both canals.

To examine the auditory chamber from the medial direction, the inner wall was partially removed (Pl. xxxv, fig. 2). Beginning from the upper edge of the *fenestra ovalis* and running upwards and inwards is a broad, thin, bony lamella (*l*), constricted in the middle and

forming a bridge, the medial wall of the exterior semicircular canal. The tunnel thus formed opens posteriorly into the opisthotic vestibular recess, anteriorly into the prootic vestibular recess.

In the absence of sutures it is impossible to say in what bony elements the various parts of the bony labyrinth lie, but it is evident that, while simple in structure, the labyrinth is better developed than in the Testudinidae, though not so complicated in structure as in the Pleurodira.

Vertebral Column.

Cervical vertebrae.—One of the skulls (now in the Mining Museum, Sydney) described by Owen[24], has the first and second cervicals attached. Another vertebra, regarded by Owen[25] as probably a dorsal, also belongs to the cervical region, as stated by Lydekker[26]. The biconcave vertebra figured by Owen[27] as the first caudal, is really the fourth cervical, as shown below.

Among the material preserved in the Australian Museum is a complete cervical series, though, unfortunately, the atlas and the eighth vertebrae are imperfect and all the processes are broken off short. This specimen (Pl. xxxvii, fig. 1) was treated with acetic acid and the vertebrae carefully separated, so that the articulations of the centra might be examined. The neck, as preserved, is 19.5 cm. in length, but making allowance for the missing parts, its probable length would be 23 cm. The individual vertebrae are short, indicating that *Meiolania* was a short-necked animal. Of the atlas only a part of the odontoid, consisting of a deep cup with its rim, is preserved. Into this cup fitted the ball of the second vertebra, which is convexo-concave. The third is also convexo-concave, the fourth convexo-convex, the fifth to seventh concavo-convex. The eighth is convex in front, but its posterior portion is missing. All the vertebrae are deeply cupped, and the ball which fits into this concavity is roughly hemispherical, or, particularly in the later vertebrae, somewhat ovoid, the longer axis being horizontal: there are no ginglymoid articulations. The zygapophyses, where preserved, show no great variation throughout the series. They are situated fairly high above the centra, the average distance from the lowest point on the base of the neural canal front to the middle point of the prezygapophysial articulating surface being about equal to the greatest vertical diameter of the centrum. The articulating surfaces of the zygapophyses form angles of about 45 degrees to the vertical.

24 Owen—Phil. Trans., clxxix, B, 1888 (1889), pl. xxxii.
25 Owen—Loc. cit., pp. 184-185, pl. xxxv, figs. 1-3.
26 Lydekker—Brit. Mus. Cat. Foss. Rept., iii, 1889, p. 162.
27 Owen—Loc. cit., pp. 185-186, pl. xxxv, fig. 4.

The second and third cervicals are very similar. A strong lateral process (diapophysis of Owen) arises partly from the neural arch, partly from the body, and is situated well on the anterior half of the vertebra, though almost entirely behind the prezygapophysis. The bodies of these two vertebrae are flattened on the lower surface, and the postero-lateral angles are produced backwards and outwards in two well developed processes, terminating in flat or slightly concave surfaces, evidently for the support of cervical ribs; for slender bones, looking like ribs, were found associated, but not attached. The succeeding vertebrae have no inferior lateral processes of this kind. On the sixth, seventh, and eighth, below and anterior to the diapophysis, is a short, blunt process (parapophysis, Owen). There are no ventral keels on any of the centra, or only the slightest indication of such.

The presence of neural spines is indicated, but they are all injured, and give little information as to their form or size. I am, however, in a position to say that some of the posterior vertebrae at least, had fairly long spinous processes. Attached to the inner surface of the plastron described above, close to the front of the anterior lobe, were two vertebræ agreeing in all essentials with the late cervicals just described. Both have well developed neural spines (Pl. xxxvii, figs. 2, 3), a very unusual feature in chelonians, either living or extinct. These high neural spines were probably confined to the last two or three cervicals.

The general structure of the cervical vertebrae of *Meiolania* indicates that it had a short but flexible neck, which could be bent in any plane. Assuredly it could not withdraw its head under its shell; its neck was too short and the cranial horns, too, would prevent retraction. The strong lateral processes, and the presence of high neural spines on some, at least, of the vertebrae indicate considerable muscularity. Probably these are adaptive characters associated with the large size and weight of the head and the presence of cranial horns, and it may be that the latter were not merely ornamental, or an expression of exuberant growth, but were weapons of defence or offence. *Meiolania* may have had enemies, or perhaps the horns were used in combats with its fellows, as described by Captain T. Hutton, in the case of *Testudo elegans*[28]. One can well imagine that in such wrestling bouts the cranial horns and long strong tail of *Meiolania* would be very effective. On the other hand, it is possible that these bizarre features were of no use whatever, but were excrescences, such as frequently appear in senile types.

If the transverse processes are adaptive, as suggested above, their presence cannot justifiably be used as evidence of pleurodiran affinities. In fact it is difficult, on the evidence of the cervical vertebrae, to say whether *Meiolania* was a cryptodire or a pleurodire. The zygapophyses strongly resemble those of typical cryptodires,

[28] Hutton—Journ. Asiatic Soc. Bengal, vi, 1837, pp. 693-4.

though the absence of true ginglymoid articulations, and the presence of strong transverse processes, are more characteristically pleurodiran. The diapophyses, which in living pleurodires, are wholly behind the prezygapophyses, in cryptodires almost underneath them, have in *Meiolania* an intermediate position. Baur considered that the structure of the atlas and axis vertebrae attached to the skull described by Owen is cryptodiran, but Boulenger argued that they show pleurodiran characters. It is doubtful whether the condition of the two vertebrae in question is such as to allow of a definite pronouncement one way or the other, for their structure and relations are not clearly shown. The most reasonable view would seem to be that *Meiolania* was a primitive form, in which the cervical region had not yet developed the special features which are characteristic, respectively, of Cryptodira and Pleurodira. In this respect it invites comparison with the Amphichelydian suborder, as defined by Lydekker[29], and more fully by Baur[30], and Hay [31].

Dorsal vertebrae.—Portion of the dorsal region, consisting of three imperfect vertebrae, with rib heads and fragments of attached carapacial plates, is in the collection. This specimen presents no notable features except the extreme thinness of the carapace, which has been alluded to previously.

Sacrum. (Pl. xxxvii, figs. 4, 5).—This is of the usual chelonian type, consisting of two vertebrae. The anterior vertebra is strongly procoelous, the cup being 4.2 cm. in width and 2.8 cm. in height. It has well-developed lateral processes (sacral ribs) arising mainly from the centrum, but partly also from the neuroids. The second vertebra is similar to the first, but the ribs are more slender. The ball of the second vertebra projects boldly backwards on a neck, and is noticeably wider than high. The zygapophyses of the two vertebrae are fairly well developed, and evidently there was quite free motion between the last dorsal and the first sacral, and perhaps a slight motion of the two sacrals on one another. The presence of strong sacral ribs is evidence against pleurodiran affinity, for in these they are degenerate, the pelvis being supported by its rigid attachment to plastron and carapace. The condition of the sacral ribs is confirmatory of the observation above, that the pelvis was not suturally attached to the plastron. Boulenger has already pointed out that *Meiolania* differed from typical pleurodires in that the ilium showed a surface for attachment to a sacral rib[32].

[29] Lydekker—Quart. Journ. Geol. Soc., xlv, 1889, p. 518; Brit. Mus. Cat. Foss. Rept., iii, 1889, p. 204.

[30] Baur—Amer. Nat., xxiv, 1890, pp. 534, 535; Proc. Acad. Nat. Sci. Phila., 1891, pp. 411-419.

[31] Hay—Bull. Amer. Mus. Nat. Hist., xxi, 1905, pp. 137-175; Fossil Turtles of N. America, Carnegie Institution, 1908, pp. 21, 43-102.

[32] Boulenger—Proc. Zool. Soc., 1887, p. 554.

Caudal vertebrae.—These have been fully described by Owen, and I need not discuss them here, except to recall their opisthocoelous character and the presence of large chevron bones, which are, in most cases, firmly ankylosed to the centra. The collection, however, contains some caudals in which the chevron bones have been detached, leaving a rough sutural surface. The tail of *Meiolania* was evidently very flexible in its anterior portion, as indicated by the deeply concave centra, but its termination was immovably enclosed in a nodose bony sheath. In this respect *Meiolania* resembled the glyptodonts.

Appendicular Skeleton.

Shoulder girdle (Pl. xxxviii, fig. 1).—No complete shoulder girdle has been obtained, the best example in our collection lacking the upper portion of the scapula, which, however, is known from other specimens to have been long and rod-like. The procoracoid makes a very obtuse angle with the body of the scapula proper, and stands nearly at right angles to the axis of the coracoid, which is expanded at its free end. This description is based on the nearly complete left girdle found attached to the plastron described above. The glenoid fossa is elongated in the direction of the axis of the scapula and procoracoid, and constricted in the middle. All parts are firmly united in this specimen.

Humerus (Pl. xxxviii, figs. 2-5).—This corresponds best with Wieland's chelic type[33]. Its proximal end is unlike that of a typical land tortoise, such as *Testudo*, nor does it present the features characteristic of marine turtles, such as *Chelonia* and *Dermochelys*. The head is large, ovoid, its longer axis inclined slightly upwards and forwards when the bone is held in the natural position. The ulnar process is broad and flattened, rises almost as high as the head when the bone is held with its long axis vertical, and is placed almost in the plane of the distal end. It is separated from the head by a well marked groove. The radial process is shorter and stouter, and stands nearly at right angles to the ulnar; between it and the head are two grooves separated by a ridge. There is a wide flaring digital fossa between the two processes, as in *Chelydra*. The shaft is sigmoid, but the curvature is not so marked as in the Testudinidae and Emydidae. It is compressed slightly in the plane of the distal end, the dorso-ventral being to the antero-posterior diameter as 31 to 34, about. The distal end consists of two large, almost equal, condylar surfaces, the ento- and ectocondyles, separated by a shallow groove. These articular surfaces are directed strongly downwards when the long axis of the shaft is held in a horizontal position. They are well marked off from the smaller entepi- and ectepi-condyles. The ectepicondylar groove commences about the middle point of the shaft, runs obliquely downwards and outwards, and becomes converted into a foramen, which emerges on the ventral surface near the proximal

[33] Wieland—Amer. Journ. Sci., (4), ix, 1900, pp. 415-416.

edge of the entepicondyle. There is a well marked supracondylar fossa on the ventral surface of the distal end, and on the dorsal surface is a shallow depression separating the two condylar surfaces and reaching a short distance up the shaft. The humerus shown in Pl. xxxviii, figs. 2, 3, has the distal end incomplete, but allowing for the missing part it would have a length of about 14 cm. The distance from the outside of the ulnar to the outside of the radial process is 9 cm., the least diameter of the shaft 22 mm. The distal end shown in Pl. xxxviii, fig. 4, measures 9.5 cm. across the condyles in the antero-posterior direction, and another even larger is 11.5 cm. in the same direction.

On the whole, the humerus of *Meiolania* was a powerful well muscled bone. Its proximal end resembles that of *Chelydra*, *Emys*, *Chelodina*, and other river and marsh turtles, but its distal end bears more resemblances to that of the Testudinidae.

Lower Limb Bones.—Several bones of the fore-arm, crus, carpus, and tarsus, are contained in our collection, but they are mainly fragments, and I am not able to add anything of importance to our knowledge of these parts of the skeleton.

Terminal phalanges.—A number of these are in the collection. They are short and almost hoof-like, as in *Testudo*, with well developed condylar surfaces. So far as its terminal phalanges are concerned, *Meiolania* was typically terrestrial.

Pelvis (Pl. xxxix, figs. 1-3). Several fragmentary pelves and one nearly complete one (found in attachment to the plastron previously described) are in the Australian Museum collection. The axis of the ilium forms a very obtuse angle with the plane of the pubes, and its upper end is expanded for attachment to the sacral ribs. The anterior branch of the pubes is broad, not slender, as in typical pleurodires. The lateral pubic (pectineal) process (*p. pr.*) is separated from the body of the pubis by a slight neck, and it has a roughened, somewhat thickened, expansion terminally where it rested on the plastron. The ischium apparently had a postero-lateral process, which, however, has not been preserved. There is a short prepubic process (*pr. pr.*). The ischiadic and pubic symphyses are connected by a broad bony bridge, separating the paired pubo-ischiadic foramina (*pb. is. f.*), as in Emydidae and Testudinidae. The pelvis presents a strong similarity to that of the Testudinidae, and is quite unlike that of existing pleurodires.

Femur (Pl. xl, figs. 1, 2).—This is a robust bone, strongly impressed for the insertion of muscles. Its head is large, slightly compressed in a plane perpendicular to that of the distal end, has an indistinct neck, and its axis stands out at an angle of about 130 degrees to the axis of the shaft. The two trochanters are very similar; the greater trochanter falls distinctly below the highest point of the head, and its direction is almost a continuation of the axis of

the shaft. The lesser trochanter turns slightly outwards. Both trochanters are thickened at their proximal ends, and their planes are almost at right angles to that of the distal end. There is a deep, but not wide, inter-trochanteric fossa. The shaft is nearly cylindrical at the point where its diameter is least. It flattens out considerably towards the distal end, which is composed of two condylar surfaces, separated by a pronounced ridge, and forming an obtuse angle with one another. The specimen illustrated in Pl. xl, fig. 2, is 21 cm. in length, measures 8 cm. across the two trochanters in an antero-posterior direction, the least diameter of the shaft is 2.7 cm., and the antero-posterior measurement of the distal end 9.5 cm.

Eggs.

There are four eggs in the collection which, from their size, spherical form, and mode of occurrence, are thought to be those of *Meiolania*. The figured specimen (Pl. xl, fig. 5) measures about 7.2 cm. in diameter.

MEIOLANIA MACKAYI *sp. nov.*

Occurrence.—Walpole Island, where the specimens on which this description is based were found, lies about one hundred miles south-east from New Caledonia, in Lat. 22° 38′ S., Long. 168° 27′ E. Mr. F. Danvers Power has described the island, the mode of occurrence of the phosphate deposits in which the bones of *Meiolania* were discovered, and the following notes are condensed from his account[34]. It appears to be situated on the same ridge as the Loyalty Islands, rises about 210 feet above the sea, the high land having an area of 296 acres. There is no fringing reef, but at the foot of the precipitous cliffs is a flat reef. The island appears to be composed entirely of coral rock, and has evidently continued to rise, probably in stages, for traces of at least five distinct flat reefs can be seen in the cliffs. There are two main lines of depressions in the surface of the coral rock, approximately at right-angles to one another, and it is in these depressions that the guano (containing the *Meiolania* bones) is found.

Mr. E. C. Andrews says[35]: "The Loyalties, together with Walpole Island, appear to have formed unstable units as compared with the main western block of New Caledonia, and they show the evidence of warping, the islands forming a crest of a land wave, while the corresponding troughs lie east and west of the island-dotted crest."

The bones are found scattered promiscuously through the phosphate, and are mostly imperfect and broken. The material comprises cranial horn cores, parts of humeri, the proximal end of a femur, and some of the lower leg bones. Scanty though the remains are, they indicate the presence of at least five individuals.

[34] Danvers Power—Trans. Inst. Min. Metall., 1919-1920, pp. 38-41.
[35] Andrews—Journ. Roy. Soc. N.S. Wales, lvi, 1922, p. 23.

Horn Cores.—These present a marked resemblance to those of *Meiolania platyceps*, as may be seen by comparing figs. 5 and 6 of Pl. xxxii with figs. 3 and 4. It is evident that they were directed upwards and backwards as in *M. platyceps*, not chiefly outwards as in *M. oweni* and *M. argentina*. They are more slender than those of *M. platyceps*, and, as this appears to be a constant feature, it seems to justify the erection of a new species, though it is barely possible that a larger series would show a gradation and enable the two to be united under the name *Meiolania platyceps*.

Humerus.—This too is very similar to that of *M. platyceps*, but it is much smaller. The proximal end (Pl. xxxviii, fig. 6) shows the wide digital fossa and the broad, flattened ulnar process; the radial process is missing. The distal end (Pl. xxxviii, figs. 7, 8) presents essentially the same features as that of *M. platyceps*.

Femur.—Only the proximal end is represented (Pl. xl, fig. 3). It has the deep, narrow, trochanteric fossa characteristic of *M. platyceps*, and its general form is the same.

Tibia.—The tibia figured in Pl. xl, fig. 4, is a slenderer bone than that of *M. platyceps*, but comparison with Owen's figure of the latter[36] will prove their essential similarity.

It is evident that *M. platyceps* and *M. mackayi* were very alike in skeletal structure so far as comparison can be made, and that they differed chiefly in size, *M. mackayi* being a smaller animal of less robust build. They both differed from *M. oweni* and *M. argentina* in the shape and direction of the large parietal horn cores.

SUMMARY AND CONCLUSIONS.

The remains of the aberrant chelonian *Meiolania platyceps* of Lord Howe Island contained in the collections of the Australian Museum and the Mining Museum, Sydney have been re-examined. Treatment of various skull portions with dilute acetic acid removed the calcareous matrix and enabled me to study the cranial foramina and the bony labyrinth in detail. At the same time certain sutures were discovered in the skull, which indicate that the pterygoid extended backwards, cutting off the quadrate from contact with the basicranial bones. A damaged plastron was found, with attached pectoral and pelvic girdles, and the discovery was made that the pelvis was not suturally connected with the plastron. These facts, together with the presence of strong sacral ribs throw doubt on the supposed pleurodiran affinities of *Meiolania*. Examination of the cervical vertebrae, of which a complete series was available, leads to

[36] Owen—Phil. Trans., clxxix, 1888 (1889), B, pl. xxxvi, figs. 1-4.

the belief that *Meiolania* was unable to withdraw its head under its carapace either in a vertical or in a horizontal plane, though it could probably move its head freely in any plane. Its limbs resemble most those of river or marsh turtles, and indicate that *Meiolania* was in all probability a strong swimmer, though it lacks the special adaptations characteristic of pelagic chelonians, such as *Chelonia* and *Dermochelys*. Its terminal phalanges resembled those of a typical terrestrial form. The occurrence on Walpole Island, which is composed entirely of coral and phosphate rock, of a new species *Meiolania mackayi*, very similar to *M. platyceps* of Lord Howe Island, indicates that *Meiolania* could undertake a sea voyage. Mr. A. R. McCulloch is of opinion that *Meiolania platyceps* was marine in habitat, and came ashore only to deposit its eggs, but I am rather inclined to the view that *M. platyceps* and *M. mackayi* were partly land, partly estuarine or shore-living forms, which could, however, make short sea trips.

As regards the affinities of *Meiolania*, it presents several features which link it with the sub-order Amphichelydia, which flourished in the Mesozoic and early Tertiary. If this is a reasonable view, we must regard *Meiolania* as a "relict" form, which, becoming extinct in other parts of the world, found its last home in the Australasian region. In this respect it takes its place with the monotremes, *Sphenodon, Neoceratodus, Heterodontus,* and other archaic forms, which still linger in Australasia, "the land of living fossils."

Its distribution does not necessarily support the hypothesis that South America and Australia were once connected by a northerly extension of the Antarctic continent. *Meiolania platyceps* and *M. mackayi* probably came from Asia, passing down the arc formed by New Guinea, New Caledonia, the Loyalties, and other islands. A submarine plateau extends northwards from Lord Howe Island towards New Caledonia, and is separated from Australia by deep ocean[37]. As the animal could apparently cross stretches of ocean a continuous land bridge would not be necessary. Mr. Tom Iredale informs me that the migration route suggested here for *Meiolania platyceps* and *M. mackayi*, was also that followed by many birds, such as *Tricholimines sylvestris, Turdus xanthopus* and *Porphyrio* (*Notornis*) *albus* of Lord Howe Island, and that all the Lord Howe Island land shells are New Caledonian in origin, as also its wingless insects. *Meiolania oweni* of the Darling Downs doubtless belongs to another branch of the same family, which crossed to Australia, probably from New Guinea, and remained more purely terrestrial in habit.

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37 This area corresponds approximately to Hedley's Melanesian Plateau (Proc. Linn. Soc. N.S.W. (2), vii, 1892, p. 335).

ACKNOWLEDGMENTS.

I have pleasure in acknowledging the cordial assistance I have received from various friends during the course of this investigation. I had the great privilege of discussing the *Meiolania* question with Dr. E. C. Case of Michigan during his recent visit to Australia, and his advice and criticism has been most helpful. To Mr. A. R. McCulloch I am indebted for an account of the occurrence of *Meiolania platyceps*, and to Dr. H. Leighton Kesteven, Professor T. T. Flynn, and Mr. Tom Iredale for information on various points. The drawings were prepared by Misses Phyllis Clarke and Helen E. Bailey, and my colleagues Messrs. A. R. McCulloch and G. P. Whitley, the photographs by Mr. G. C. Clutton to all of whom my best thanks are due. To my colleague Mr. T. Hodge Smith I am indebted for assistance in the acetic acid treatment of the fossils, and also for the preparation of the map, which is based on Etheridge's geological map and data supplied by Mr. A. R. McCulloch.

MOLLUSCA FROM THE CONTINENTAL SHELF OF EASTERN AUSTRALIA.

By

TOM IREDALE.

(Plates xli-xliii, and map.)

INTRODUCTION.

Our knowledge of the fauna of the continental shelf is so imperfect that any additional data are acceptable. This year, Mr. C. W. Mulvey, manager of the New State Fish and Ice Company, Sydney, has interested himself in assisting the Australian Museum by presenting specimens trawled by his fleet, and has given facilities for members of the Museum staff to collect. The results of Mr. Mulvey's activities form the basis of this report.

The oldest material from the continental shelf consists of a few hauls made by the "Challenger," which, curiously enough, were overlooked and mixed with Atlantic material, and, when reported upon, caused a lot of trouble which, even now, needs rectification. Simultaneously the "Gazelle" made a haul or two, from which a few species were described. The "Thetis" trawled along the coast in depths up to eighty fathoms, and the study of the material by Hedley instigated further research and he continued the work until the arrival of the "Endeavour." This ship explored the shelf from end to end, but, unfortunately, through the tragic ending of the enterprise, the results are comparatively unknown. A brief account, culled from some notes left by the lamented Dannevig, was published under Hedley's direction. In that paper a scanty résumé of the nature of the continental shelf was presented, but nothing relating to the fauna. Only a few large molluscs were recorded from Dannevig's collection, all from the south-east corner of this State, but I find a small series of smaller molluscs in the Australian Museum, and I have utilised some of these in this report.

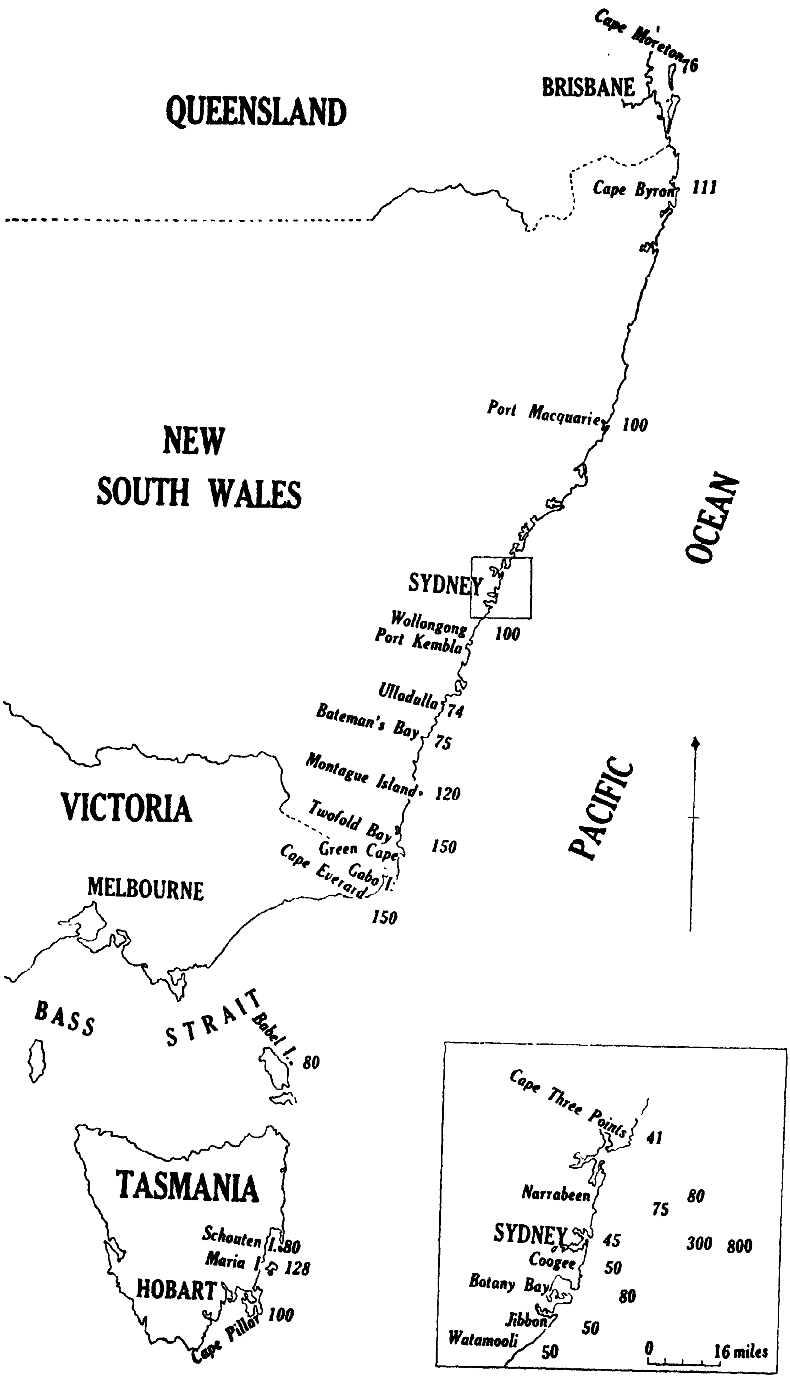
In the introduction to his report on the "Thetis" mollusca, written over twenty years ago, Hedley concluded: "The above facts suggest certain inferences. Firstly, that such beds as the Eocene of Muddy Creek, Victoria, represent a fauna of the hundred fathom zone; and that, if the age of the Tertiary beds are to be calculated by Lyellian percentages, an exploration of the hundred fathom zone in existing Australian seas must precede an estimation of the dates of Australian Tertiaries. Secondly, that some living representatives of the Eocene Mollusca of Victoria now dwell six or seven degrees north of where their predecessors lie; a conclusion agreeable to the hypothesis that the Eocene climate was warmer than the present."

Roy Bell made a large collection of mollusca in and around Twofold Bay, upon which I have reported, and during my study of this collection I became impressed with the fact, that the so-called Eocene shells of Muddy Creek, Victoria, were living in that locality in water from twenty to seventy fathoms deep. Further I found that the shallow water species appreciably changed as they survived in deeper water, and that these deepwater forms were scarcely specifically separable from the "Eocene" fossils. I suggested that the best way of expressing the relationship was by means of a trinomial nomenclature, as, when series were examined, the value of the differences observed became prejudiced by the personal equation, some authors denying, others affirming the specific identity of the fossils and recent species. Study of the present collections has given me the opportunity of comparing other species, and I am more than convinced that the relationship can be clearly seen only if trinomials be utilised. I also suggest that if trinomial nomenclature were used in zonal work, many of the difficulties now met with by palaeontologists would soon be dissipated.

Judging from the series I have now examined, I believe that on the continental shelf most of the species of the upper beds of Muddy Creek, correlated with the Kalimnan, will be found living, and that the Lyellian percentage method would class these beds very high. Apparently, so far, little attention has been paid by palaeontologists to the differences to be observed in the species found in these beds, and variable fossils have been distributed as typical without reference to the type description or locality; for example, shells from Muddy Creek have been distributed as norms of species described from Table Cape, and vice versa, and shells in the Australian Museum, forwarded as typical of fossil species, are quite discrepant, and in some instances more than one species is represented in such a lot. The study of palaeoconchology, when once again it is undertaken in Australia, must first of all deal with series of topotypes of described species before discussing the sequence and age of the beds. Simultaneously, series of recent shells should be accumulated from depths varying from shallow to deep water and from northern and southern localities. Comparison of such series would enable trustworthy deductions to be made. In the following notes suggestions are made, through study of series of recent shells, as to the relationship of some apparently allied fossils.

I have compiled a list of the localities on the continental shelf whence collections of molluscs are at present available, and in the accompanying map the position of the shelf is indicated by the soundings in the neighbourhood of the hundred fathoms line.

The name in brackets indicates the worker who has discussed the collection and A.M. signifies material in the Australian Museum not previously reported upon.



Cape Moreton 76
BRISBANE
QUEENSLAND
Cape Byron 111
Port Macquarie 100
NEW SOUTH WALES
OCEAN
SYDNEY
Wollongong
Port Kembla
100
Ulladulla 74
Bateman's Bay 75
Montague Island 120
PACIFIC
VICTORIA
Twofold Bay
Green Cape
150
Cape Everard
Gabo I.
150
MELBOURNE
BASS STRAIT
Babel I. 80
TASMANIA
Schouten I. 80
Maria I. 128
HOBART
100
Cape Pillar
Cape Three Points 41
Narrabeen
75
80
SYDNEY
45
300
800
Coogee
50
Botany Bay
80
Jibbon
50
Watamooli
50
0
16 miles

I append a bibliography of the papers relating to the molluscan fauna of this shelf.

Locality.	Depth in Fathoms.	Collection.
North of Cape Moreton, Qld.	76	"Gazelle" (Martens)
Off Cape Byron, N.S.W.	111	Halligan (Hedley).
Port Macquarie	100	Hedley.
Cape Three Points	41-50	"Thetis" (Hedley).
Narrabeen, 22 miles	80	Haswell and Hedley.
„ 15 miles	75-80	Mulvey (A.M.).
Sydney, 5 miles	45	"Challenger" (Tenison-Woods, etc.).
„ 27½ miles	300	Hedley and Petterd.
	410	"Challenger" (Smith).
„ 35 miles	800	Haswell and Hedley.
	950	"Challenger" (Smith).
Coogee	49-50	"Thetis" (Hedley).
Botany Heads	33-56	McNeill and Livingstone (A.M.).
Botany Bay	79-80	"Thetis" (Hedley).
Jibbon	50-66	"Thetis" (Hedley).
Watamooli	50-66	"Thetis" (Hedley).
Wollongong	55-66	"Thetis" (Hedley).
„ 16 miles	100	Halligan and Hedley.
Port Kembla	63-75	"Thetis" (Hedley).
Ulladulla	74	Mulvey (A.M.).
Bateman's Bay	75	Mulvey (A.M.).
Montague Island	120	"Challenger" (Angas).
Twofold Bay, 3 4 miles ..	25-30	Livingstone and Fletcher (A.M.).
„ ..	39-46	Livingstone and Fletcher (A.M.).
„ ..	30-70	Mulvey (A.M.).
„ ..	150	"Challenger" (Hoyle).
Green Cape	50-70	Roy Bell (A.M.).
Between Green Cape and Gabo Island	50-100	"Endeavour" (Hedley).
Gabo Island	80	"Endeavour" (A.M.).
South from Gabo Island	100-250	"Endeavour" (Hedley).
South-east from Cape Everard, 27 miles	90 150	"Endeavour" (A.M.).
Edge of Eastern Slope, Bass St.	80-110	"Endeavour" (A.M.).
East of Babel Is., Tas, 20 miles	59 80	"Endeavour" (A.M.).
Off Schouten Is.	40-80	May.
East of Maria Is., 20 miles ..	128	"Endeavour" (A.M.).
Off Cape Pillar, Tas., 7 miles	100	Hedley and May.

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Angas, G. F.—Proc. Zool. Soc. (Lond.), 1877, p. 179. Dredged twenty-five miles off Montague Island, at a very great depth, by H.M.S. "Challenger", *fide* Brazier, 120 fathoms.

Brazier, J.—Proc. Linn. Soc., N.S.W., vol. i, 1875, p. 89. Dredged forty-five fathoms five miles east of Sydney by "Challenger" party.

Dannevig, H.—Biological Results F.I.S. "Endeavour," vol. iii, 1915, pp. 337-353. The continental shelf of the East Coast of Australia. Bass Strait.

Hedley, C.—Rec. Austr. Mus., vol. iv, 1901, pp. 26-27. Some new or unfigured Australian shells. "Challenger" party shells, as under Brazier (*supra*).

Proc. Linn. Soc., N.S.W., vol. xxvi, 1901, pp. 22-25. On the "Challenger" Station, 164b.

Mem. Austr. Mus., iv, pt. 5, 1902, pp. 285-324; pt. 6 (Oct. 8), 1903, pp. 325-402. Scientific Results of the Trawling Expedition of H.M.C.S. "Thetis," Mollusca, parts i and ii.

Proc. Linn. Soc., N.S.W., vol. xxviii, 1904, pp. 182-211. Studies in Australian Mollusca, part viii. Includes new species and records from 100 fathoms, 16 miles east of Wollongong.

Rec. Austr. Mus., vol. vi, 1905, pp. 31-54. Mollusca from one hundred and eleven fathoms, east of Cape Byron, New South Wales (12½ miles).

Rec. Austr. Mus., vol. vi, 1906, pp. 211-225 (with W. Petterd). Mollusca from three hundred fathoms, off Sydney (27½ miles).

Rec. Austr. Mus., vol. vi, 1907, pp. 273-304. Mollusca from eighty fathoms, off Narrabeen (22 miles).

Rec. Austr. Museum, vol. vi, 1907, pp. 356-364. Mollusca from eight hundred fathoms, 35 miles east of Sydney.

Rec. Austr. Museum, vol. vii, 1908, pp. 108-125 (with W. L. May). Mollusca from one hundred fathoms, seven miles east of Cape Pillar, Tasmania.

Biological Results F.I.S. "Endeavour," vol. ii, pt. 2, 1914, pp. 70-74. Mollusca from north and south of Gabo Island (50-100 fathoms north and 100-250 fathoms south).

Proc. Linn. Soc., N.S.W., vol. xxix, 1915, p. 711. Off Port Macquarie, N.S.W., 100 fathoms.

Hoyle, W. E.—"Challenger" Reports, Zool., vol. xvi, 1886, p. 203. Station 163a, off Twofold Bay, 150 fathoms.

Martens, E. von—Forschungsreise "Gazelle," Zool., Bd. iii, 1889, pp. 262-266. Off Cape Moreton, 76 fathoms.

May, W. L.—Papers, Proc. Roy. Soc., Tas., 1910, pp. 380-398. New marine Mollusca (from 40-80 fathoms, off Schouten Island).

Smith, E. A.—"Challenger" Reports, Zool., vol. xiii, 1885, p. 15. Station 164, off coast New South Wales, 950 fathoms; 164b, off Sydney, 410 fathoms.

Proc. Zool. Soc. (Lond.), 1891, pp. 438-445. Descriptions of new species of shells from the "Challenger" Expedition. Station 164b, off Sydney, 410 fathoms.

Proc. Malac. Soc., Lond., vol. i, 1894, pp. 59-60. Note on shells from "Challenger" Station 164, 410 fathoms, off Sydney.

Tenison-Woods, J. E.—Proc. Linn. Soc., N.S.W., vol. ii, 1878, pp. 262-266. On some new marine shells (from 45 fathoms, *ex* Brazier, *q.v.*).

Watson, R. B.—"Challenger" Reports, Zool., vol. xv, 1886, p. 706. From 35 fathoms, off Sydney.

In addition to these, reference must be made to Verco's papers —on the mollusca dredged in deep water off the south and west Australian coasts—running through many years in the Transactions of the Royal Society of South Australia, also to Hedley's "Report on the Mollusca obtained by the F.I.S. 'Endeavour', chiefly off Cape Wiles, South Australia[1]," and his "Results of Dredging on the Continental Shelf of New Zealand[2]."

The new names proposed in this paper are as follows:—

Barbatia (pistachia) separata nov.
Ovaleda gen. nov. for *Sarepta? tellinaeformis* Hedley.
Nuculana oculata sp. nov.
Lima [*bassii*] *benthonimbifer* nov.
Chlamys instar sp. nov.
Chlamys famigerator sp. nov.
Chlamys perillustris sp. nov.
Vimentum subgen. nov. for *Venericardia dilecta* Smith.
Venericardia excelsior leguleja subsp. nov.
Venericardia (*excelsior*) *semota*, nov.
Placamen gen. nov. for *Venus placida* Philippi.
Placamen placidum molimen subsp. nov.

[1] Hedley—Biol. Results "Endeavour," i, 1911, pp. 90-114; *id.*, 1914, pp. 65-70.
[2] Hedley—Trans. New Zealand Inst., xxxviii, 1905, (1906), pp. 67-75.

Emarginula curvamen sp. nov.
Emarginula amitina sp. nov.
Fautor legrandi tentabundus subsp. nov.
Obex mulveyana gen. et sp. nov.
Fusus (schoutanicus) conterminus nov.
Fusus bednalli volaticus subsp. nov.
Berylsma (grandis) levifida nov.
Fax gen. nov. for *Phos tabidus* Hedley.
Fax (tenuicostata) conspicienda nov.
Tasmeuthria gen. nov. for *Siphonalia clarkei* Ten.-Woods.
Trigonostoma vinnulum sp. nov.
Cancellaria purpuriformis aurifer subsp. nov.
Microsveltia gen. nov. for *M. recessa* sp. nov.
Pepta gen. nov. for *Admete stricta* Hedley.
Ctenocolpus gen. nov. for *Turritella australis* Lamarck.
Ctenocolpus australis diffidens subsp. nov.
Terebra (lauretanae) tabifica nov.
Scaphander illecebrosus sp. nov.
Obrussa bracteata gen. et sp. nov.
Stilapex lactarius gen. et sp. nov.

BARBATIA (PISTACHIA) SEPARATA *nov.*

The specimens, picked from a boulder trawled off Narrabeen, 75-80 fathoms, differ, in a few minor details, from a series collected on the littoral at Port Fairy (Victoria), and Twofold Bay (New South Wales). They agree in showing a sharp angulation posteriorly and being shortly rounded anteriorly while they have less height; they are white inside, with four brownish lines radiating laterally from umbo. I have supported the recognition of Lamarck's *Arca pistachia*[3] as being identical with Smith's *A. radula*[4], described from Bass Straits, the illustration of specimens from 4½ to 38 fathoms agreeing very closely with the Port Fairy shells. The relationship of the deeper living shell is best represented by the trinomial above given, but the fossils, *Barbatia consutilis* Tate[5], from Muddy Creek, Victoria, type 41 x 20 x 16 mm., distinguished from *Barbatia limatella* Tate[6] by its attenuate posterior side, and the latter, from Aldinga Bay—compared with *decussata* Sowerby, from which it was separated "by its longer and straighter hinge-line, longer posterior side, and

[3] Lamarck—Hist. Anim. s. Vertcb., vi, 1, July, 1819, p. 41.
[4] Smith—Challenger Reports, Zool., xiii, 1885, p. 260, pl. xvii, fig. 3, a.b.
[5] Tate—Trans. Roy. Soc. South Austr., viii, 1886, p. 142, pl. ii, fig. 15.
[6] Tate—Trans. Roy. Soc. South Austr., viii, 1886, p. 141, pl. x, fig. 2.

by the stronger and more laminar and oblique teeth on the marginal areas"—appear to be as nearly allied. The characters used in diagnosing the fossil species are not very reliable when a series of specimens of the recent variable species is criticised. Trinomial nomenclature, as advised by me[7], seems the only mode of writing the relationships.

OVALEDA TELLINAEFORMIS *Hedley*.

Hedley described *Sarepta ? tellinaeformis*[8], *and then later*[9] admitted the identity of his species with the fossil *Leda obolella*[10] Tate, but noted slight differences and considered his reference to *Sarepta* justified on account of the presence of an exterior ligament. The species recalls *Yoldia* much more than *Sarepta*, and there appears to be a group of southern bivalves superficially like *Yoldia*, even as *Malletia* is mimicked by *Pseudomalletia*. I have examined series of recent and fossil shells, and note that the recent forms are generally higher, deeper, with coarser sculpture, the beaks a little more angulate, and the hinge teeth fewer. These differences seem to call for the use of a trinomial; thus *Ovaleda* [*obolella*] *tellinaeformis* Hedley would immediately show that the relationship between the two forms was very close and of disputable value. I propose the generic name *Ovaleda*, naming Hedley's *Sarepta ? tellinaeformis* as type. This species is in the Australian Museum from off Port Kembla, Cape Three Points, Botany Heads, Sydney and Narrabeen, but not, as yet from southern localities.

NUCULANA OCULATA *sp. nov*.

(Plate xlii, fig. 9.)

Shell large for the genus, very solid, white, almost equilateral, apically smooth, followed by shallow poorly marked ridges, more like pronounced growth lines. Posterior side almost straight, a little concave, angulate, anterior side sloping, faintly convex, dorsal margin shallowly curved. Umboes a little incurved. Hinge teeth very long, angulate, fourteen to sixteen on each side, ligament pit deeply sunk. Muscle scars deep, pallial line well marked, with a small pallial sinus.

Length, 17.5 m.m.; height, 13 mm.

Off Narrabeen, 75-80 fathoms.

Only a single left valve occurred, but as it needs comparison with no other species, either recent or fossil, I have named it.

7 Iredale—Proc. Malac. Soc. Lond., xv, 1922, pp. 37-8.
8 Hedley—Rec. Austr. Mus., iv, 1901, pp. 26, f.8 in text.
9 Hedley—Mem. Austr. Mus., iv, 1902, p. 295.
10 Tate—Trans. Roy. Soc. South Austr., viii, 1886, p. 129, pl. v, fig. 3, a.b.

LIMA [BASSI] BENTHONIMBIFER *nov.*

Dealing with the common recent shell. known as *Lima multicostata* Sowerby, I named it *Lima nimbifer*[11], and concluded: "The deep water shell[12] known as *L. bassii* Tenison-Woods[13] (given to a fossil) appears to be the benthal representative of this species." Good specimens were found alive on the block trawled off Narrabeen in 75-80 fathoms, and they appear to be smaller and a little more regular, with the sculpture a little better defined than the littoral shell, and, as Hedley proposed[12], may be referred to the fossil, or perhaps are, as I regarded them, little changed forms of the recent species. Hedley's figure is of a small shell, and the largest one from deepwater yet examined measures 22 x 17 mm.; the fossil also appears to be small, while the littoral shell reaches a fine size, up to 60-70 x 40-45 mms., a fragment of a giant suggesting that it may reach even up to 90 or 100 mm. in length.

Limatula strangei Sowerby[14] appears to vary more. Hedley[15] has indicated Thiele's confusion with the littoral forms, and the fossil *Lima jeffreysiana* Tate[16] was distinguished "by its straighter sides, by its more numerous [number not given, but stated to be distant] and acute ribs, and by being more ventricose." These are very variable features in the growth stages of the littoral forms, and therefore indicate the very close affinity of the species, whose relationship would be best expressed by means of trinomials, though the differences are more pronounced than in the case of the *Lima*.

CHLAMYS INSTAR *sp. nov.*

(Plate xli, figs. 5, 6, 7.)

Chlamys antiaustralis Hedley, Biol. Res. F.I.S. "Endeavour" i, 1, 1911, p. 96 (specimens from 100 fathoms, off Cape Pillar only). *Id.*, May, Proc. Roy. Soc. Tasm., 1912, p. 44, and Check-list Moll. Tasm., 1921, p. 10, and Illustr. Index Tasm. Moll., 1923, pl. iii, fig. 8. Not *C. antiaustralis* Tate, Trans. Roy. Soc. South Austr., viii, 1886, p. 106, pl. 9, fig. 7.

This is the species referred to by Hedley as being represented in the Cape Pillar dredging by numerous valves reaching up to 100 mm. Adult shell nearly orbicular with ears nearly equal; immature shell higher than broad with ears normally unequal. The adult sculpture is distinctive, in that the ribs bear closely appressed lamellae throughout, while the *asperrimus* series have the lamellae erect. The juvenile

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11 Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 196.
12 Hedley—Proc. Linn. Soc. N.S.W., xxviii, 1904, p. 201, pl. ix, f. 28.
13 Tenison-Woods—Proc. Roy. Soc. Tasm., 1876, p. 112.
14 Sowerby—Conch. Icon., xviii, 1872, pl. iii, sp. 15.
15 Hedley—Proc. Linn. Soc. N.S.W., xlviii, 1923, p. 302.
16 Tate—Trans. Roy. Soc. South Austr., viii, 1885 (1886), p. 119, pl. iv, f. 8.

sculpture consists of about twenty-four rather distant flattened ribs without lamellae, the prodissoconch rather large, smooth, shining; the interstices between the ribs, at first smooth, develop regular curved lines like the rungs of a ladder, but these soon close up and the small ribs develop small scales regularly appressed. At each side of the primary a small rib similarly ornamented arises, and then, as growth continues, another similar stronger rib is intercalated, the interval between each bunch of five riblets also showing a central ridge. The elevation of the primary rib preserves the lamellae on the adjoining ribs, whilst those on the rib itself disappear.

Colour variable, generally creamy to pale buff externally, purple internally, with a small pallial line and a large white muscle scar, generally coalescing with the line. Hinge line straight, very minutely serrate medially, deep triangular ligament pit. Ears with radials, numerous and ornamented with minute lamellae in left valve, few on auricles of right valve, six on posterior, four to six on anterior, ctenolium large and furrowed.

Type, length (or height) 97 mm.; breadth 96 mm.; depth of single valve 14 mm.; juvenile figured, right valve, height 17 mm., breadth 14 mm.

Off Cape Pillar, Tasmania, in 100 fathoms.

CHLAMYS FAMIGERATOR *sp. nov.*

(Plate xli, figs. 1, 2.)

Chlamys antiaustralis Hedley, Biol. Res. F.I.S. "Endeavour," i, 1 1911, p. 96 (specimens from 100 fathoms off Wollongong, N.S.W., not those from 100 fathoms off Cape Pillar, Tas., and perhaps those from 100 fathoms off Cape Wiles, South Australia).

Chlamys antiaustralis Hedley, Check-list Marine Fauna, New South Wales, Mollusca, p. M 8 (Journ. Roy Soc. N.S.W., li, Suppl.), June 19, 1918. Not *C. antiaustralis* Tate.

Shell small, flattened, ears unequal, suborbicular, sculpture peculiar; prodissoconch small, smooth, about twenty-four ribs developed, a little flattened and unadorned at first, then developing lamellae in a discrepant manner on the left valve, more regularly on the right, which is a little more convex. On the left valve the lamellae occur on every third or fourth rib, the intervening ribs remaining smooth. At a little older stage the ribs on the right valve are regularly surmounted by smaller scaly lamellae, the broad interstices are at first concentrically lined but the sculpture becomes irregular and broken with age, and intercalating ribs spring up.

Colour variable; shades of yellow and orange, sometimes pinkish, variegated with white or paler blotches or streaks, internally similarly coloured.

Hinge-line straight, narrow, right valve with long ridge bearing minute serration on each side of small ligament pit, with corresponding serrated groove in left valve.

Ears: In the right valve the posterior auricle is small, with four wavy radials not much sculptured; the anterior auricle is large, with six radials crossed with erect scales, ctenolium deep. The left valve has the ears unequal, the anterior large with nine radials, distantly scaled, posterior small, with five similarly ornamented radials.

Type: Right valve, height 15; breadth, 14 mm.; left valve, height 17 mm.; breadth 16 mm. Off Green Cape, 50-70 fathoms (R. Bell). type locality. Off Bateman's Bay, 75 fathoms (Mulvey). Off Eden, 30 fathoms (Livingstone and Fletcher). Off Wollongong, 100 fathoms (Hedley).

Apparently well distributed, but no large specimens yet recognised. This species is allied to *Pecten* (*Chlamys*) *dichrous* Suter[17], from New Zealand, which Suter refers to the neighbourhood of the Miocene fossil *Pecten chathamensis* Hutton[18], but I have not yet traced the Australian fossil representative. The New Zealand *dichrous* measures as much as 32 mm. by 36 mm., retaining the peculiar sculpture, so that the Australian shell may also continue with the erratic ornamentation, though at first sight this seems doubtful.

The species, fossil and recent, of the *asperrimus*[19] group are in a chaotic state, owing to the variability of the common shell, and it has been a difficult task to separate the present species. Roy Bell sent me an extensive series of large and small shells and valves of *Chlamys* from Twofold Bay, 20-25 fathoms, and off Green Cape, 50-70 fathoms. After as many as possible were referred to *asperrimus*, three distinct species could be recognised: the one here named, another unnamed form, and one determined as *blandus* Reeve[20], but the last-named seemed a form of *asperrimus* with peculiarly well-developed lamellae.

The reference of the present species to C. *antiaustralis* Tate seemed doubtful, and upon application to Mr. F. A. Singleton, of the University of Melbourne, he forwarded me a series of the species recognised by the Victorian palaeontologists as Tate's species. These agreed with Tate's description, but were specifically inseparable from the shell regarded as Lamarck's *asperrimus*. Consequently, if any species were to be called *antiaustralis*, it would be a deepwater shell, such as we now regard as *asperrimus*. The two species here described have been confused and recorded as *antiaustralis*, but they are clearly separable, the young of the large species being of a different shape when equivalent in size to the smaller species.

17 Suter—Proc. Malac. Soc. (Lond.), viii, 1909, p. 264, pl. xl, fig. 31.
18 Hutton—Cat. Tert. Moll. New Zeal., 1873, p. 29.
19 Lamarck—Hist. Anim. s. Verteb., vi, 1819, p. 174.
20 Reeve—Conch. Icon., viii, 1853, pl. xxxiv, sp. and fig. 162.

CHLAMYS PERILLUSTRIS *sp. nov.*

(Plate xli, figs. 3, 4.)

While on the difficult group of *Chlamys*, the present beautiful and distinct deep-sea species may be named.

Shell of medium size, flattened, ears very unequal, thin, obliquely oval. Right valve apically smooth, then ornamented with about twenty slender radial ribs, the interstices between very broad; the ribs are a little wavy at first, later obliquely radiating with a gentle curve; lamellae arise and these are placed rather distant, and, growing angulate and tallish, resemble thorns; the interstices between the ribs are minutely scratched longitudinally; the sculpture on the left valve is similar, but the prickles begin at an earlier stage, and are more closely packed posteriorly.

Colour pale orange to orange brown; internally white.

Hinge line straight, ligamental pit triangular, small, with scarcely perceptible ridge and corresponding groove very minutely serrated.

Ears: the posterior auricle of the right valve is small, obliquely ranged with three or four prickly lines; the anterior auricle has four ribs crossed by strong lines almost like lamellae, and the ctenolium is broad, shallow and lined; the posterior auricle of the left valve is small and scarcely ribbed, only oblique growth lines occurring; the anterior auricle has half a dozen linear ribs furnished with fine prickles.

Length (height) of type 29 mm., breadth 25 mm.

From 150-250 fathoms off Gabo Island. Also from 128 fathoms 20 miles east of Maria Island. This species has little to do with any other Australian scallop, save *Pecten challengeri* E. A. Smith[21], dredged by the "Challenger" in 410 fathoms off Sydney (station 164b).

VENERICARDIA EXCELSIOR *Verco.*

(Pl. xlii, fig. 8.)

Venericardia calva Hedley, Check-list Marine Fauna, New South Wales, Mollusca, p. M. 17 (Journ. Roy. Soc. N.S.W., li, Suppl.). Not *Cardita calva* Tate, Trans. Roy. Soc., S.A., ix, 1886, p. 189, pl. xx, fig. 14.

Specimens from Ulladulla, 74 fathoms, were easily recognised as being referable to the group ranged round *dilecta* Smith[22], which may be subgenerically designated by the new name *Vimentum.* Upon investigation the shells appear to be referable to Verco's species, but

[21] Smith—Proc. Zool. Soc. (Lond.), 1891, p. 443, pl. xxxv, fig. 25.
[22] Smith—Challenger Reports, Zool., xiii, 1885, p. 213, pl. xv, figs. 4, 4a.

may be classed as variants thereof. Hedley has accepted the reference to Tate's fossil species *calva,* which is incorrect. Tate's species was described from the older beds of Muddy Creek, has twenty ribs, measuring 5.25 x 5 mm., while Verco's *excelsior*[23] has nearly thirty ribs, and the New South Wales shells have thirty or over. While the size of *excelsior* is given as 7.8 x 7.3 mm., and the habitat is from 100-150 fathoms off the South Australian coast, the Ulladulla shells reach 9 x 8 mm., and are similar to specimens from 80 fathoms off Narrabeen, and 100 fathoms off Wollongong. A single valve from 111 fathoms off Cape Byron is referable to a distinct species. Specimens from 7-10 fathoms off Montague Island are easily separable by their larger size, are notably flatter, with the dorsal edge straighter, and measure 10 x 9 mm.

A complex series is thus observed. Smith's *dilecta* from 17-45 fathoms, Bass Strait and South Australia, is represented in 100-150 fathoms, South Australia, by Verco's *excelsior.* The fossil *calva* Tate is more distantly allied, not conspecific. On the east coast a representative of Verco's *excelsior* is met with in 74-100 fathoms, and a well marked form in shallow water, 7-10 fathoms. The relationships may be written thus:—

VENERICARDIA, *subgenus* VIMENTUM.

Venericardia calva Tate. Fossil.
dilecta Smith, Bass Strait, and South Australia, 17-45 fathoms.
(*dilecta*) *excelsior,* Verco, South Australia, 100-150 fathoms.
excelsior legulcja subsp. nov. East Australia, 74-100 fathoms.
(*excelsior*) *semota,* nov. (Pl. xlii, fig. 8), East Australia, 7-10 fathoms.

There seems to be a rule that deep-water molluscs from the east coast are represented by very similar forms on the south coast in deeper water.

CLAUSINELLA PLACIDA *Philippi.*

Under this name a fairly common species is included by Hedley[24], and illustrated by May[25]. When Roy Bell's shells were received numerous specimens were recognised from shallow water, but these were at once seen to differ from the type of *Clausinella,* a British species, in the hinge teeth. A long series of species occur in Australasian waters, so that I propose the new generic name *Placamen,* naming *Venus placida* Philippi[26] as type. The relationship of the

[23] Verco—Trans. Roy. Soc. S.A., xxxii, 1908, p. 348, pl. xiv, fig. 9.
[24] Hedley—Check-list Marine Fauna, N.S.W., Moll. 1918, p. M. 24 (Journ. Roy. Soc. N.S.W., li, suppl.).
[25] May—Illustr. Index Tasm. Shells, 1923, pl. x, fig. 9.
[26] Philippi—Abbild. Beschr., i, Apl. 1844, pt. 28, Venus, pl. 2, fig. 2.

forms is interesting, as *Venus placida* was described from a small shell from "Insula Van Diemen," which does not show the characteristics of the southern Tasmanian form. In this the shape is somewhat triangular, the ribs erect and distant, about fifteen on a normal shell, thus agreeing with the fossil *subroborata* Tate[27] which was separated on account of its fewer ribs, namely fifteen, the comparison being made with a more closely ribbed form like that from Twofold Bay; the fossil, however, differs in the prolongation of the posterior side. The Twofold Bay shell differs more from the southern recent shell than that does from the fossil, being less triangular, more closely ribbed, twenty ribs being easily counted in a shell of the same size, the posterior edge still less angulate, and the ribs less erect. This form extends up to Sydney. From the Ulladulla boulder trawled in 74 fathoms, a few dead valves, apparently representing a deeper water form, were obtained; these were proportionately still broader and more closely ribbed.

The names suggested at present read:—

Placamen placidum Philippi, Southern Tasmania.
= *roboratum* Hanley[28], same locality.
placidum molimen subsp. nov., New South Wales.
[*placidum*] *subroboratum* Tate, fossil.

Emarginula curvamen *sp. nov.*

(Plate xlii, figs. 10, 11.)

Shell elevated, round-backed, apex incurved, projecting beyond the edge of the base, anterior slope very convex, posterior slope almost perpendicular. Colour cream.

Slit long, about one-fourth the length of anterior slope, furrow a channel showing distant growth bridges, the edges a little uneven. Sculpture consisting of about twenty primary ribs, with about an equal number of subordinate ones crossed by twenty to forty concentric ridges, forming indistinct nodulation at points of intersection and shallow pits at intervals.

Length 8.5; breadth 5.5; height 4 mm.

From 128 fathoms, twenty miles east of Maria Island, Tasmania.

This distinct species needs no comparison with any described form.

[27] Tate—Trans. Roy. Soc. South Austr., ix, 1886 (Mch., 1887), p. 157, pl. xiv, fig. 17.

[28] Hanley—Proc. Zool. Soc., (Lond.), 1844 (Feb., 1845), p. 161; Recent Shells, 1856, p. 361, pl. 16, sp. 25.

EMARGINULA AMITANA *sp. nov.*

(Plate xlii, figs. 12, 13.)

Shell depressed, apex posterior, at about posterior fourth, incurved, anterior slope convex, posterior slope a little concave, steep. Colour very indefinite, greeny white alive, chalky white as dead shells. Slit very long, about one-third the length of anterior slope, furrow a canal, marked with regular rather distant growth bridges. Sculpture consisting of about fifty strong evenly spaced radials, crossed by about twenty concentric ridges, forming indistinct nodules, the interspaces appearing as pits. The sculpture becomes bolder with age, the juvenile shell being comparatively weakly engraved.

Length 11.5; breadth 7.5; height 4 mm.

Off Ulladulla, 74 fathoms; two live specimens living on boulder, the edges of the shell being, in consequence, uneven. Though the figure may suggest *E. bajula* Hedley[29], it is no close relation, as this species is referable to *Emarginula*, while *E. bajula*, judging from the muscle scars, is a species of *Emarginella*[30], a conclusion also arrived at by Hedley since the publication of his check-list. On the boulder was also living another *Emarginula*, which I cannot separate from *E. hedleyi* Thiele[31], though a series might show variation from that littoral species. A fossil relation of this species appears to be *Emarginula transenna* Tenison-Woods[32] from Table Cape, which may be intermediate between *E. candida* A. Adams[33] and *E. hedleyi* Thiele.

NARICAVA ANGASI *A. Adams and Angas.*

Adeorbis angasi, A. Adams and Angas, Proc. Zool. Soc. (Lond.), 1863 (1864), p. 424, pl. 37, figs. 11, 12.

Naricava angasi Hedley, Proc. Linn. Soc., N.S.W., xxxviii, 1913, (Nov. 5), p. 294.

When Hedley proposed the genus *Naricava* at the place quoted, he referred it to the neighbourhood of *Vanikoro*, and later placed it in the family Merriidae (*Merria* = *Vanikoro*), but did not describe the operculum, nor have I seen any description.

A live specimen, picked from the boulder trawled off Ulladulla in 75 fathoms, shows the operculum to be thin, horny, paucispiral, like that of *Uber* (=*Polinices olim*), and not like that of *Merria*. I have described a similar operculum for *Korovina*[34], which may thus prove closely allied.

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29 Hedley—Proc. Linn. Soc. N.S.W., xxxviii, 1913, p. 276.
30 Pilsbry—Man. Conch., xii, 1891, pp. 249, 269.
31 Thiele—Conch. Cab., B. ii, Abth. 4a, 1915, p. 81, pl. ix, figs. 27, 28.
32 Tenison Woods—Proc. Roy. Soc. Tasm., 1876, (1877), p. 103.
33 A. Adams—Thes. Conch., iii, 1863, p. 213, pl. 246, figs. 45, 46.
34 Iredale—Proc. Malac. Soc., (Lond.), xiii, 1918, p. 31.

FAUTOR LEGRANDI TENTABUNDUS *subsp. nov.*

I[35] added the species [36] to the New South Wales fauna by means of dead shells dredged by Roy Bell, but Livingstone and Fletcher, of the Australian Museum, collected live specimens in 25-30 fathoms off Twofold Bay, which show the northern form to possess much weaker sculpture, which is clearly seen on the base. The postnuclear whorls also show faint nodulation, and the sutures are noticeably, though shallowly channeled. On the typical form thirteen cords can be counted on the base, with sometimes intercalating lines, the interstices crossed with fine radial threads. In the present form the base is sculptured with half a dozen flattened ribs near the umbilicus, generally followed by a smooth space about the width of three ribs, and then three weaker ribs with no distinct radials. Operculum typically trochoid. With the lot was also a typical *Fautor comptus* A. Adams[37], the type of the genus *Fautor*[38].

Since my separation of the Trochoid groups I have received Thiele's "Revision des Systems der Trochacea," (which although titled "Eingesandt im Dezember 1921" was apparently published only in February, 1924) as a separatum from the Mittheil. Zool. Mus., Berlin, Band xi, pp. 47-74. This revision is based primarily on radular characters, and Thiele has pointed out that the European shells referred to *Calliostoma,* and recently allowed subgeneric rank as *Jujubinus,* are not related to *Calliostoma* in the widest sense, but are near *Cantharidus,* a genus of the Trochoids proper. Thiele places *Jujubinus* as a sub-genus of *Cantharidus,* allowing two other subgenera *Thalotia* and *Bankivia.* Then *Phasianotrochus* is regarded as a section of *Cantharidus* s. str., *Leiopyrga* as a section of *Bankivia,* and *Alcyna* and *Odontotrochus* as sections of *Thalotia.* Throughout the essay Thiele's groups are of unequal value, and most of his subgenera should at once be raised to genera, and many of his sections also deserve that value. In the present case *Leiopyrga* is generically distinct from *Bankivia,* while *Alcyna* is decidedly not congeneric with *Thalotia.* The placing of *Fautor* next to *Thalotia* can be recommended, as I have already suggested.

In the subfamily Margaritinae Thiele places *Stomatella,* observing that the radula proves it to be related to *Euchelus,* and no relation of *Stomatia* at all. As *Stomatella* is the oldest generic name the name of the subfamily should have been Stomatellinae, and we can use this for our series of shells without discussing the relationship of the Arctic *Margarites* at all. Thiele classes *Perrinia, Danilia, Euchelus* with section *Herpetopoma* and subgenus *Tallorbis, Stomatella* with section *Hybochelus,* and *Solariella=Machaeroplax.* The last named may be omitted from our series as I have already given some notes on this subject.

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[35] Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 229.
[36] Tenison-Woods—Proc. Roy. Soc. Tasm., 1875 (1876), p. 154.
[37] A. Adams—Proc. Zool., Soc., (Lond.), 1854 (1855), p. 38.
[38] Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 230.

TELEOCHILUS ROYANUS *Iredale.*

This new species, described[39] from shallow water, appears in a more delicate deep-water form all along the continental shelf. I find that the "Endeavour" brought in a dead specimen from 80 fathoms off Gabo Island. Livingstone and Fletcher found a couple (dead) off Eden, and I collected a dead shell from the boulder trawled in 75-80 fathoms off Narrabeen; all these were inhabited by hermit crabs. None approach the fossil more closely than the original lot, but, as these show variation, the fossils from different localities may also intergrade, and a series necessitating the use of trinomials be secured.

OCEX MULVEYANA, *gen. et sp. nov.*

(Plate xliii, fig. 22.)

A genus of the Cymatiidae (?), small size, no posterior canal, sculpture peculiar, variced each half whorl.

Shell small, elongately fusoid in shape, spire longer than aperture, aperture narrow.

Colouration pinkish brown mottled with darker blotches, the varices showing one or two cream bands, the basal half of the last whorl paler pink strongly mottled with brown.

Whorls seven, plus an erect apical smooth two and a half whorls, convex, sutures impressed, varices each half whorl, a little irregularly placed, broad, and distinctly seen as a convex band. Sculpture consisting of from twelve to sixteen longitudinal ribs, between each varix cut into nodules by weak transverse cords, which increase from five on the second whorl to eleven on the penultimate, increasing in numbers on the body whorl. Columella smooth, continued as a glaze on body whorl, anteriorly produced angularly. Mouth obliquely oval, anterior canal short, open, no trace of posterior canal, outer lip thickened internally, not toothed, edge thin.

Length of type 35; breadth 15; aperture 16 x 5 mm. Paratype (apical whorls missing), 35 x 16 mm.

From block trawled in 74 fathoms off Ulladulla.

This fine new species is named after Mr. C. W. Mulvey, as it was through his enthusiasm that the shells were secured.

[39] Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 264.

Relations.—The group or groups of which this is one of the finest members, may later prove of immense value to palaeontologists, as many species have been described by Tate, under the genus *Epidromus*, from various fossil deposits, and now they are commonly turning up on the continental shelf. At present *Fusus brazieri* Angas [40], *Fusus bednalli* Brazier[41], *Fusus mestayerae* Iredale[42], and *Fusus schoutanicus* May[43], are known, but two or three other species are in the Australian Museum collection, and a form of the last named was obtained from the boulder trawled off Narrabeen in 75-80 fathoms, but only one dead shell was secured. The present species needs comparison with *Epidromus texturatus* Tate[44], a fossil from Muddy Creek. The apex of *Fusus mestayerae*, compared with that of *F. schoutanicus*, was figured by May, when he introduced the latter species. As above noted a similar small form reaches as far north as Narrabeen in the same depth, but from 100-250 fathoms off Gabo Island many specimens of a form allied to *schoutanicus*, yet almost as large as *mestayerae*, were trawled and these may be named *Fusus (schoutanicus) conterminus* nov. Compared with *F. mestayerae* this form is broader, the sculpture is coarser, the varices more pronounced, and the apex comparatively smaller. Contrasted with *F. schoutanicus* it is much larger, sculpture more delicately marked, the shell thinner, and the apex more strongly sculptured. Variation in size and shape are seen in all three forms.

Fusus bednalli was described as *Epidromus bednalli* by Brazier from Guichen Bay, South Australia, and the New South Wales shell so identified is much smaller, smoother, narrower, and is probably specifically distinct, but until more material is available, it may be classed as a subspecies with the new name *Fusus bednalli volaticus*. A near fossil ally is *Epidromus leptoskeles* Tate[45] from the lower beds at Muddy Creek, while *Pisania tenuicostata* Tenison-Woods[46] should be compared with May's *schoutanicus* and *conterminus* above.

It will be noted that I am here discussing *Fusus* in connection with the genus *Obex*, which I have placed in the family Cymatiidae (?), although *Fusus* has been shown to belong to a different family, Fusidae. My reason for doing this is to attract attention to the relationship of the fossils, which have never been carefully criticised. The apex of *Obex* and some of the fossils, for example *E. texturatus* Tate, is of a different kind, and needs serious consideration. There is generally an eccentric twisting in the larger species of *Fusus*, as *brazieri* Angas, which is not seen at present in *Obex*.

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40 Angas—Proc. Zool. Soc., (Lond.), 1869, p. 46, pl. ii, fig. 3.
41 Brazier—Proc. Linn. Soc. N.S.W., i, 1875, p. 6.
42 Iredale—Trans. New Zeal. Inst., xlvii, 1914 (1915), p. 466.
43 May—Proc. Roy. Soc. Tasm., 1910, p. 389, pl. 14, fig. 14.
44 Tate—Trans. Roy. Soc. S.A., x, 1887, p. 139, pl. vi, fig. 10.
45 Tate—*Ibid.*, p. 129, pl. iv, fig. 10.
46 Tenison-Woods—Proc. Linn. Soc. N.S.W., iii, 1878, p. 224, pl. xxi, fig. 6.

CYMATIUM WATERHOUSEI *A. Adams and Angas.*

Triton waterhousei, A. Adams and Angas, Proc. Zool. Soc. (Lond.), 1865, p. 35. Port Lincoln, South Australia.

A shell referable to this species was found among a large series of shells, trawled off Twofold Bay in thirty fathoms, wihch Mr. Mulvey allowed to be examined. This is the first record of the species from New South Wales.

BERYLSMA WAITEI *Hedley*

In the lot just mentioned above half a dozen specimens of this species inhabited by hermit crabs, some from shallower water, some from deeper water, showed benthal variation exactly as I[47] suggested recently. A shore shell, stout, heavy, measured 120 mm. in length and 61 mm. in breadth, the aperture and canal measuring 70 mm. A specimen from thirty fathoms was pale orange coloured, lighter, mouth not much strengthened, lining weak, 135 mm. long by 61 mm. broad, the aperture and canal measuring 80 mm. A deep water shell from 60-70 fathoms was delicate, pure white, outer lip thin, not lined internally, not much glaze on inner lip, 148 mm. long by 61 mm. broad, the aperture and canal measuring 90 mm. This last was obviously a typical *Fusus waitei*[48], which measured 150 mm. x 60 mm., the ribbing also agreeing in character, extending on the whorls, whereas with the shallow water forms it was more restricted to the shoulders.

A corrected nomenclature would therefore read:—

Berylsma grandis Gray. Tasmania.

Berylsma (grandis) levifida nov. Off Twofold Bay, shallow water.

Berylsma (grandis) waitei Hedley. Off New South Wales coast, deeper water, 50-80 fathoms.

FASCIOLARIA BAKERI *Gatliff and Gabriel*

Fasciolaria australasia Perry var. *bakeri* Gatliff and Gabriel, Victorian Naturalist, xxix, 1912, p. 47, pl. xiii, figs. 3, 4 (lettered 1, 2).

In the same lot was a large series of this species accompanied by a single typical *F. a. coronata* as understood in New South Wales: these are of great importance as they definitely establish the specific

[47] Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 267.
[48] Hedley—Mem. Austr. Mus., iv, 1903, p. 373, pl. 37.

distinction from the recent *coronata*, but they undoubtedly are closely related to the fossil *Fasciolaria decipiens* of Tate[49], who, when describing this species from the "Lower beds at Muddy Creek; gastropod-bed at the River Murray Cliffs; Table Cape . . ." observed: "Each locality has its own racial variety, and it may be desirable, when fuller material is at hand, to apply distinctive names to each." *Fasciolaria* [*decipiens*] *bakeri* Gatliff and Gabriel *would succinctly indicate the relationship of the recent form.*

FAX *gen. nov.*

(Plate xliii, figs. 19, 21.)

I propose this generic name for the shell Hedley introduced as *Phos tabidus*[50], but later transferred to *Euthria*[51]. I[52] have recently discussed the varied species referred to the genus *Euthria* in connection with Cooke's[53] illustration of the radular features. The present species was brought back by Livingstone and Fletcher from 39-46 fathoms off Twofold Bay (pl. xliii, fig. 19) and was not at first determined as it was unlike a *Euthria*. I found in the Australian Museum collection a young live specimen from 27 miles south and east of Cape Everard in 90-150 fathoms that contained the operculum, which is oval, horny, nucleus apical.

Apparently an allied species is Tenison-Woods' *Cominella tenuicostata*[54], which is placed under *Euthria* by May[55], and which may be transferred to *Fax*. From 100 fathoms off Cape Pillar, Tasmania, a beautiful deep water shell was recorded by Hedley and May as *tenuicostata*, which should certainly be distinguished as *Fax* (*tenuicostata*) *conspicienda* nov. (Pl. xliii, fig. 21). This is longer, narrower, much more finely sculptured, lacking the strong longitudinal costae, and of more delicate texture and beautifully coloured, being pale cream marked with square spots of orange. The fossil *Phos cominelloides* Tate[56] should be carefully compared with this. The other species placed under *Euthria* by May, *Siphonalia clarkei* Tenison-Woods[57], has more resemblance to the Neozelanic *Euthria*, but still differs, so that I propose to retain the association by introducing the new generic name *Tasmeuthria*, naming *S. clarkei* as type.

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49 Tate—Trans. Roy. Soc. S.A., x, 1887 (1888), p. 150, pl. viii, fig. 1.

50 Hedley—Proc. Linn. Soc. N.S.W., xxix, 1904, p. 191, pl. 8, fig. 8.

51 Hedley—Check-list Mar. Fauna N.S.W., 1918, Moll. p. M 87 (Journ. Roy. Soc. N.S.W., li, suppl.).

52 Iredale—Proc. Malac. Soc. (Lond.), xiii, 1918, pp. 33-34.

53 Cooke—Proc. Malac. Soc. (Lond.), xii, 1917, pp. 232-235.

54 Tenison-Woods—Proc. Roy. Soc. Tasm., 1876 (1877), p. 135.

55 May—Check-list Moll. Tasm., 1921, p. 81.

56 Tate—Trans. Roy. Soc. South Austr., x, 1887 (1888), p. 167, pl. iv, f. 11.

57 Tenison-Woods—Proc. Roy. Soc. Tasm., 1875 (1876), p. 6.

Family CANCELLARIIDAE.

A beautiful new species, secured by Roy Bell, was left unnamed in my essay, as there were so many complications. Some more specimens referable to this family necessitate an attempt (which I find Hedley had intended to make) to unravel the tangle. Firstly, it is doubtful if any true *Cancellaria* appears in this fauna, but the name may be used in the wide sense pending further research. Again, species of varied aspect are numerous in the fossil beds. Then, the *Trigonostoma* series is easily recognisable at sight, and *Admete* does not occur in any sense in Australian waters.

The species on Hedley's New South Wales list when reorganised would be:—

801 and 803 *Trigonostoma vinnulum* Iredale.
802 *Cancellaria undulata* Sowerby.
805 *Cancellaria scobina* Hedley.
805A *Cancellaria purpuriformis* Kuster.
804 *Microsveltia exigua* Smith.
804A *Microsveltia recessa* Iredale.
806 *Pepta stricta* Hedley,

and some more species to be added.

Genus TRIGONOSTOMA *Blainville.*

Trigonostoma Blainville, Manuel de Malac., 2nd edition, 1827, p. 652.

Type by monotypy and tautonymy *Delphinula trigonostoma.*

I have not noted the record of a second edition of Blainville's work, but at Marseilles I bought a copy of the first issue in its original boards, which was completed at p. 648. In the usual copies of this second edition, "Nouvelle additions et Corrections aux Genera" occupy p. 649-664. These begin with the words, "Je comprendrai sous ce même titre un certain nombre d'observations nouvelles, qui me sont parvenues depuis la publication du Manuel de Malacologie." On p. 653, Octobre 1826 is quoted, and on p. 654 the genera *Westernia* and *Gervisia* of Quoy and Gaimard mentioned, which are commonly quoted as of Rang's "Manuel Mollusques," p. 139, May, 1829.

TRIGONOSTOMA VINNULUM *sp. nov.*

(Pl. xliii, fig. 18.)

Shell small, solid, oval fusiform, minutely perforate, mouth practically free. Colour creamy fawn, banded with reddish brown, the bands noticeable on the outer lip.

Apical whorls, one and a half, smooth, the succeeding five whorls with stout, elevated, somewhat rounded ribs, twelve on the penultimate whorl crossed by six threads, the shoulder concave, ribs higher than suture, slanting forwards.

Umbilicus small, narrow, edged with rib, lined internally. Mouth triangular; columella three plaited, the anterior smallest, the posterior plait largest; a distinct glaze crosses body whorl to posterior angle of outer lip. Outer lip thick, bevelled internally, with ten to fifteen lines inside, a posterior angular nodule present.

Type: Length 12.5; breadth 7 mm.; aperture about half length of shell.

From Twofold Bay, 25 fathoms (Roy Bell).

Also in the Australian Museum from 25-30 fathoms off Nora Head, New South Wales, and 33-56 fathoms off Botany Heads, New South Wales, both collected by McNeill and Livingstone. Also from Green Point, Watson's Bay, Port Jackson, collected by J. Brazier in 1873. Apparently this latter was recorded by Angas[58] as *Cancellaria antiquata* Hinds, to which it is related only generically; it seems also to be the species Angas included as *Cancellaria costifera* Sow. var., to which it bears some resemblance.

CANCELLARIA PURPURIFORMIS *Kuster.*

(Plate xliii, fig. 24.)

Cancellaria purpuriformis Kuster, Coquilles Vivants, Canal, ii, 1841, p. 37, pl. 7, fig. 4, from unknown locality. Reeve, Conch. Icon., x, Dec., 1856, pl. xvi, fig. 76, hab. unknown.

Cancellaria tasmanica Tenison-Woods, Proc. Roy. Soc. Tasm., 1875 (1876), p. 150. King Island.

Cancellaria maccoyi Pritchard and Gatliff, Proc. Roy. Soc., Vict., xi, n.s. 1899, p. 182, pl. xx, fig. 6. Western Port, Victoria.

In general form a specimen secured by Livingstone and Fletcher in 25-30 fathoms off Eden agrees with this species, and is a new record for the State. As the shell is more elongate and is weakly longitudinally ribbed throughout, about eighteen ribs on the penultimate and body whorls, it may represent a distinct species, but at the present time it seems best to name it as a subspecies only, *Cancellaria purpuriformis anxifer,* subsp. nov.

While dealing with *Cancellaria,* another correction may be made. May illustrates *Cancellaria laevigata* Sowerby, which also occurs in Victoria. Kuster[59] has figured *Cancellaria lactea* Deshayes, from the type, noting that Sowerby[60] has since named the same species *laevigata,* which is correct, so that *Cancellaria lactea* Deshayes[61] must displace *C. laevigata.*

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[58] Angas—Proc. Zool. Soc. (Lond.), 1877, p. 186.

[59] Kuster—Coquilles Vivants, Canal, ii, 1841, p. 36, pl. vi, fig. 4. Loc. unknown.

[60] Sowerby—Conch. Illus., 1841, p. 3, pl. 11, fig. 24.

[61] Deshayes—Encyc. Meth., iii, 1832, p. 180. (The first 180, as there are two sets of pp. 1-256.)

MICROSVELTIA RECESSA *gen. et sp. nov.*

(Plate xliii, fig. 16.)

I propose the genus *Microsveltia* for the group of small species, naming the present one as type, but which would include *Cancellaria exigua* Smith, and some fossil species like *C. micra* Tate, but not *C. scobina* Hedley.

Shell very small, elongately oval, semicanaliculate, imperforate spire longer than aperture, whorls shouldered. Colour dead brownish. Apical whorls large, one and half, smooth, adult whorls four, ornamented with ten slanting longitudinal ribs, elevated and a little rounded forming a strong shoulder; transverse cords cross the shell, two on the penultimate, and one on the shoulder, five, sometimes six, on the body whorl. A short, shallow, anterior canal may be noted, the columella two plaited, the anterior one larger. An umbilical chink sometimes seen in the adult, numerous striae rarely appearing on the base of the body whorl, and between the cords. The outer lip sharp, but the heavy rib behind sometimes obscures this.

Length 6; breadth 3.5 mm.

Off Bateman's Bay, 75 fathoms.

Near *C. exigua* Smith[62] and *C. micra* Tate[63], but not identical with either.

The confusion with regard to these small species requires discussion. Smith first described *C. exigua* from the notorious "Challenger" station 164b, 410 fathoms off Sydney, 6 mm. x 3 mm., with one columella fold. Hedley and Petterd then added *Cancellaria scobina*[64], a rather larger fine species, but later, after examining a collection from 80 fathoms off Narrabeen, Hedley regarded some small shells as conspecific with his *C. scobina*, and then still later observed "I have compared an example of *C. scobina* from 80 fathoms off Narrabeen with the type of *C. micra* Tate. The fossil has more and finer spirals, but weaker radials. In size, shape, and other respects the shells are identical," and therefore reduced his *scobina* to a variety of *micra*.

Then, through acceptance of some incorrect generic location, he described *Admeta stricta*[65], and in his check-list placed his *scobina* under the genus *Admete*. The two species here noted are about as unlike the northern type of *Admete* as any shell could be, and almost certainly do not belong even to the same family.

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62 Smith—Proc. Zool. Soc. (Lond.), 1891, p. 439, pl. xxxiv, fig. 11.

63 Tate—Trans. Roy. Soc. S.A., xi, 1889, p. 158, pl. x, fig. 8.

64 Hedley and Petterd—Rec. Austr. Mus., vi., 1906, p. 222, pl. 38, fig. 12. Hedley—Rec. Austr. Mus., vi., 1907, p. 360.

65 Hedley—Rec. Austr. Mus., vi., 1907, p. 295, pl. 54, fig. 10.

The present small species from off Bateman's Bay, 75 fathoms, caused me to examine the shells above mentioned, and as suggested, I regard *Cancellaria scobina* as referable to *Cancellaria* (*sensu lato*). I determine the Narrabeen shells as distinct in every way, much nearer *exigua*, but not conspecific with Tate's *micra*, which has seven spirals on the penultimate whorl. In the Australian Museum are many sets; from 80 fathoms off Gabo Island; from 65 fathoms, 20 miles east of Babel Island; 80 fathoms off Narrabeen; and a dead fragment (probably washed down) from 800 fathoms off Sydney.

The species, named by Hedley *Admete stricta*, is so unlike the type of *Admete* as to need little comparison, but as remarked at the time is not unlike the fossil *Cancellaria turriculata* Tate[66]. I propose for the recent species the genus *Pepta* and provisionally leave it in this family.

Family TURRITELLIDAE.

I have written at some length about members of this family in my essay on Roy Bell's Twofold Bay shells, but already there is much to add. When Tate[67] dealt with the fossil species he began with "from the great variability in form and sculpture of the majority of our fossil species of this genus, one is tempted to conclude that no satisfactory position can be taken up anywhere between the extremes regarding the whole genus as an enormous protean species, or describing nearly every colony as a separate species." Fortunately we are able by means of study of recent shells to find out the characters of the operculum and radula that are of value, and then associate these with shell features, thus preparing a good basis for work upon the fossils. The genera *Gazameda* and *Colpospira* have been differentiated[68], and it is now possible that *Platycolpus* may be recognisable, and also other groups, as I propose *Ctenocolpus* for Lamarck's *Turritella australis*[69]. From 8-15 fathoms off Gabo Island, Victoria, Roy Bell sent a series of *Turritella* which were quite different from any received from New South Wales. They were obviously a recognisable variant of *Turritella australis* Lamarck, with the noduling missing. The apex was small, there was only a shallow sinus, not deep like that of *Colpospira* or *Platycolpus*: the whole facies of the shell was distinct, and the operculum was simple, concave exteriorly, horny and multispiral. Tate has described *Turritella pagodula*[70] from the Miocene of the Gippsland Lakes, not uncommon, which he stated "has some affinity with *T. granulifer* Tenison-Woods[71], which is, however,

[66] Tate—Trans. Roy. Soc. South Austr., xi, 1889, p. 156, pl. x, fig. 14.
[67] Tate—Trans. Roy. Soc. South Austr., xvi, 1893, p. 334.
[68] Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 247.
[69] Lamarck—Hist. Anim. s. Verteb., vii, 1822, p. 59.
[70] Tate—Trans. Roy. Soc. South Austr., xvi, 1893, p. 336, pl. viii, fig. 10.
[71] Tenison-Woods—Proc. Roy. Soc. Tasm., 1875 (1876), p. 142.

conspicuously different by its granulated keels." *Turritella warburtoni* Tate[72], from the Eocene of Table Cape, common, is more distantly related. The recent shell here noted shows subobsolete nodulation on the early whorl, otherwise there appears to be no difference from the fossil *pagodula*. It is to be remarked that the recent shell is living in the same locality as the fossil, a factor noted in other cases of Kalimnan fossils. A few dead shells and fragments from off Port Kembla, 75 to 63 fathoms, were left unnamed when Hedley reported upon the "Thetis" material, and later they have been regarded as *australis* Lam., but as no fresh material turned up this species was not included in the New South Wales list. These fragments appear to be related to the smooth form here discussed, not to the nodulose *granulifer* form which is figured by May[73] as *australis* Lam. I propose to name the Gabo Island form *Ctenocolpus australis diffidens* subsp. nov. (Plate xliii, fig. 17.)

TURRITELLA SOPHIAE *Brazier.*

(Plate xliii, fig. 23.)

Turritella incisa Ten.-Woods, Proc. Linn Soc., N.S.W., ii, 1878, p. 262. Not *T. incisa* Reeve, Conch, Icon., v, 1849, Turritella, pl. xi, fig. 63.

Turritella sophiae Brazier, Proc. Linn. Soc., N.S.W., viii, 1883, p. 227; new name for *T. incisa* Ten.-Woods. Hedley, Mem. Austr. Austr. Mus., iv, 1903, p. 348. Hedley, Check-list Marine Fauna N.S.W., 1918, Moll. p. M 59 (Journ. Roy. Soc. N.S.W. li, suppl.).

The type of this species, preserved in the Australian Museum, has been carefully examined and proves to be a young specimen of *T. sinuata* Reeve[74]; the shell recorded by May[75], under the name *T. sophiae* is not the same, and seems like *C. guilleaumei* Iredale[76].

GLYPTOZARIA OPULENTA *Hedley.*

Turritella opulenta Hedley, Rec. Austr. Mus., vi, 1902, p. 292, pl. liv, fig. 4.

Common and widely distributed over our continental shelf. Hedley observed "The sculpture is subject to considerable variation; in some examples the spiral sculpture is less, and the radial more pronounced than in the individual figured," which measured 6 x 2 mm.

72 Tate—Trans. Roy. Soc. South Austr., xvi, 1893, p. 337, pl. viii, fig. 2.

73 May—Illustr. Index Tasm. Shells, 1923, pl. xxviii, fig. 3.

74 Reeve—Conch. Icon, v, 1849, pl. xi, f. 62.

75 May—Proc. Roy. Soc. Tasm., 1915, p. 78; Check-list Moll. Tasm., 1921, p. 61; Illustr. Index Tasm. Shells, 1923, pl. xxviii, fig. 11.

76 Iredale—Proc. Linn. Soc. N.S.W., xlix, 1924, p. 248.

A specimen occurred in the material from 75 fathoms off Narrabeen, and I note that the fossil representative, very little changed, is *Turritella transenna* Tenison-Woods[77] from Muddy Creek, measuring 8.5 x 3 mm.

Tate transferred this species to *Mathilda*, but that location seems as unsatisfactory as *Turritella*, so that *Glyptozaria* may for the present remain in the Turritellidae.

TEREBRA LAURETANAE *Tenison-Woods.*

Roy Bell dredged two magnificent live specimens in 25 fathoms in Twofold Bay; they were at first regarded as new, but later recognised as a variant of this species[78], judging from Hedley's figure[79]. The two shells were much broader and showed a pronounced postsutural collar and incised line; one, fully adult with mouth free and apical whorls missing, measured 48 x 11 with fifteen whorls; the other younger, beautifully perfect and well coloured, had thirteen adult whorls, and one and a half smooth apical whorls, in a length of 40 x 9.5 mm., the mouth immature; the sculpture below the collar consists of marked longitudinal growth striae and fine transverse scratching. Another specimen received from the same locality agrees in detail, measuring 31 x 8 mm. for eleven whorls and one and a half apical whorls.

Hedley's figure showed a very narrow shell with no postsutural collar and measured 41 x 7 for sixteen whorls. This was dredged in 300 fathoms off Sydney, and as it is obviously distinct I here name it *Terebra* (*lauretanae*) *tabifica* nov. Tate's type measured 20 x 6.5 mm. In the Australian Museum collection is another specimen from off Babel Island, 59-80 fathoms, which measures 45 x 8.5 mm. for fifteen whorls and apical one and a half; this shows a narrow indistinct postsutural collar with no line. With this might be contrasted *Terebra simplex* Tenison-Woods[80], from Table Cape, with no infrasutural groove, though anterior whorls show a faint depression in the posterior third. A more distant relation appears to be *Terebra platyspira* Tate[81], later figured[82] from the lower beds at Muddy Creek, very narrow and collared.

77 Tenison-Woods—Proc. Linn. Soc. N.S.W., iii, 1879, p. 234, pl. 20, fig. 8.
78 Tenison-Woods—Proc. Linn. Soc. N.S.W., ii, 1877 (1878), p. 262.
79 Hedley and Petterd—Rec. Austr. Mus., vi, 1906, p. 222, pl. xxxvii, fig. 9.
80 Tenison-Woods—Proc. Roy. Soc. Tasm., 1875, p. 2, tab. fig. 1.
81 Tate—Southern Science Record, Jan., 1886, p. 6.
82 Tate—Trans. Roy. Soc. South Austr., xi, 1888 (1889), p. 159, pl. viii, fig. 12.

SCAPHANDER ILLECEBROSUS *sp. nov.*

(Plate xlii, fig. 14.)

Shell oval, rather solid, creamy white, transversely punctate throughout, apex imperforate. Spire concealed, so that only the last whorl is visible. Sculpture consists of rows of oval pits set concentrically, the pits of the same size in the row but with some rows of smaller pits. Aperture very large, outer lip a little sinuous posteriorly, produced medially, and well rounded basally. Inner lip as a heavy glaze across the body whorl. Columella nearly straight, imperforate.

Length 12.5; breadth 9 mm. From 20 miles east of Babel Island, 65 fathoms.

Resembles *S. mundus* Watson[83] from 800 fathoms off the Aru Islands, but the sculpture is different. The figure of *S. tatei* Cossmann[84], an Eocene fossil, somewhat resembles this, but Cossmann wrote "spire largement perforée au sommet," which effectually separates it. This is the first species from the continental shelf to be referred to *Scaphander,* and the animal will probably show easily recognised differences from the northern type.

OBRUSSA BRACTEATA *gen. et sp. nov.*

(Plate xlii, fig. 15.)

A genus of the Acteonidae (?).

Shell small, thin, oval, aperture about two-thirds the length of the shell, white, perforate, marked posterior gutter, shouldered.

The anastrophic apex is smooth, showing no varix, succeeded by four adult whorls; the sculpture on these whorls consists of delicate upstanding ridges, the interstices delicately latticed with fine longitudinal threads; six ridges on the penultimate whorl, the concave shoulder only bearing the growth lines of the posterior sinus.

The narrow perforation penetrates to the apex; columella curved; a shallow, scarcely perceptible, anterior canal may be noted, then the inner lip crosses the body whorl as a distinct glaze and meets the outer lip, which projects suddenly forward, forming a deep fairly wide gutter, then after a forward sweep recedes to make the anterior channel. Length 5; breadth 3.5 mm.

From 75-80 fathoms off Narrabeen; a similar specimen from 65 fathoms, 20 miles east of Babel Island, so that it ranges over the whole extent of the continental shelf.

[83] Watson—Challenger Reports, Zool., xv, 1886, p. 643, pl. xlviii, fig. 2.

[84] Cossmann—Trans. Roy. Soc. South Austr., xxi, July, 1897, p. 9, pl. i, figs. 34, 35.

STILAPEX LACTARIUS *gen. et sp. nov.*

(Plate xliii, fig. 20.)

A genus of the Strombiformidae, globose, vitreous, apex stiliform, operculate, probably free living, imperforate. Colour lacteous. The apex consists of two or three whorls, succeeded, sometimes irregularly, by six adult whorls, which are convex, with sutures well marked, slightly shouldered, last whorl about two-thirds the length of the shell. Aperture fairly wide, outer lip thin sinuate, columella a little thickened and reflexed, slightly sinuate posteriorly, inner lip continued as a glaze across the body whorl. Operculum thin, horny, paucispiral.

Length 8; breadth 5 mm.

From 70 fathoms 20 miles east of Babel Island.

The presence of an operculum and the sinuate outer lip suggest that this is a free living form, and quite distinct from the parasitic *Stilifer*.

May[85] appears to have figured the present species under the name *Stilifer brazieri* Angas[86], but the latter species is parasitic and altogether a narrower shell.

The plates accompanying this paper were drawn by Miss Joyce K. Allan, the map by Mr. T. Hodge Smith. To each I wish to express my indebtedness for the valuable and painstaking assistance rendered.

85 May—Illustr. Index Tasm. Shells, 1923, pl. xlv, fig. 24.
86 Angas—Proc. Zool. Soc. (Lond.), 1877, p. 173, pl. 26, fig. 12.

CONTRIBUTIONS TO THE CRANIAL OSTEOLOGY OF THE FISHES.

No. I.

Tandanus tandanus Mitchell.

BY

H. LEIGHTON KESTEVEN, D.Sc., M.D., Ch.M.

INTRODUCTION.

(Figures 1-5.)

Though presenting a general similitude throughout the class, the skull of the bony fishes is subject to a variety of modifications. These modifications affect not only the form but also the number, and therefore the relations one to another of the component bones.

These modifications have been subjected to analysis from time to time incidentally to the description of several isolated forms. Except however in text books, where perforce the reviews are brief, no general attempt has been made to harmonise the various modifications.

The Director, Dr. C. Anderson, has kindly placed at my disposal a very fine series of heads of Elasmobranchs and Teleostei. From the American Museum of Natural History I have received heads of *Amia*, *Acipenser*, *Lepidosteus*, and other Teleostei. My thanks are also due to Dr. T. L. Bancroft of Eidsvold, Queensland, for *Ceratodus* heads.

With all this mass of material to work upon, it is hoped to present a comprehensive review of the piscine cranium. A series of descriptions accompanied by drawings will be offered first. In these descriptions comparative notes will be made as brief as possible. The descriptive series will be followed by a review of the whole, and it is towards this last that each of the others is contributory.

In 1922 I published "A New Interpretation of the Bones in the Palate and Upper Jaw of the Fishes[1]." Throughout this series the nomenclature there introduced will be used. In order to obviate

[1] Kesteven—Journ. Anat., lvi, 1922, pp. 307-324.

reference to that paper the new nomenclature is tabulated opposite the old below.

Old Nomenclature.	New.
Parasphenoid	Conjoint- or Mesopterygoid
Hyomandibular	Hyomandibular
Symplectic	Symplectic
Quadrate	Quadrate
Metapterygoid	Os transversum
Pterygoid or Ectopterygoid	Quadratojugal
Mesopterygoid or Entopterygoid	Palatine
Palatine	Maxilla
Maxilla	Maxillary labial
Premaxilla	Premaxillary labial
Vomer	Premaxilla
Parethmoid or Ectethmoid	Prefrontal

The terms conjoint- or mesopterygoid and os transversum were proposed in this new sense in an earlier paper[2]. Synpterygoid is a happier term and will be used in these papers. Maxillary labial and premaxillary labial are terms proposed here, which will be used in future contributions.

Skull of *Tandanus tandanus* Mitchell.

The skull has the dorso-ventral compression of the Siluroids, and, whilst conforming generally to type, it presents marked departures from the normal in the arrangement of the anterior facial components.

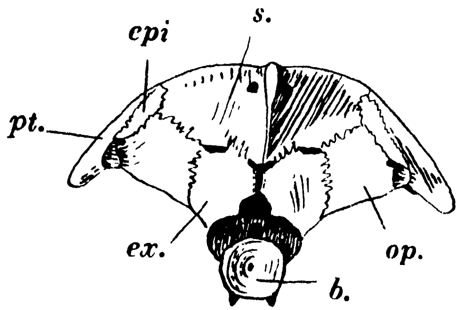

Fig. 1.—*Tandanus tandanus*, posterior aspect.

The neurocranium is roughly triangular in outline as viewed from behind (Fig. 1), two sides of the triangle being ventro-lateral and the third dorsal. The dorsum of the cranium is arched, and, being continued out and down by the pterotic processes, describes approximately one-third of a circle. The ventral plane of the skull approaches that of the roof not rapidly but evenly towards the snout. Near the anterior end of the skull, there is an abrupt down-turning of the dorsal and a less abrupt down turn of the ventral surface, so that the two surfaces meet at a point below the ventral plane.

[2] Kesteven—Journ. Anat., liii, 1919, pp. 223-238.

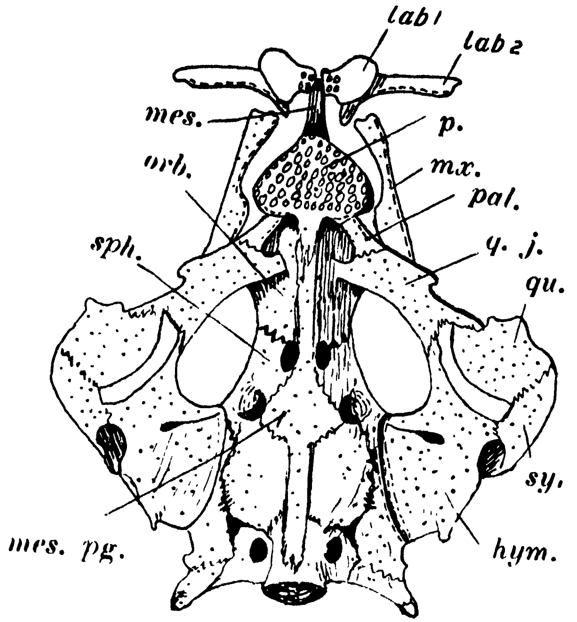

Fig. 2.—*Tandanus tandanus*, ventral aspect.

The two ventro-lateral sides (Fig. 2) are inclined to one another at a right angle in the older specimens, and at a more obtuse angle in the younger. The width of the neurocranium is reduced fairly regularly from behind forward. The large *foramen prooticum* imparts an appearance of abrupt lateral constriction just forward of the anterior limit of the hyomandibular articulation. At the anterior limit of the infraorbital vacuity, the orbitosphenoid bone contributes a laterally expanded section to the central structure. The attachment of the fore end of the suborbital arch to the ventro-lateral edges of this bone, and the heart-shaped expanse of the premaxilla immediately in front of it, give to the anterior end of the skull, as viewed from below, an appearance of massiveness which is not really present.

Viewed from above (Fig. 3) the brain box has a nearly square outline behind the orbits. The centre of the orbit (antero-posterior measurement) marks the centre of symmetrical bays which excavate the sides of the neurocranial outline. In front of the orbit the central mass of the skull maintains a roughly oblong outline for a space, and is then suddenly constricted. Beyond the point of constriction the central axis is continued by the bizarre mesethmoid only. It will be evident later that a lateral constriction of the skull in front of the orbit is hidden from above by the massive prefrontals.

The saucer-shaped articular facet and the tips of two ventral struts thereto is all that is visible of the *Basioccipital* posteriorly. The foramen magnum, immediately above the basioccipital, is shaped like a broad gothic arch. A "step" to this "door way" is formed by a narrow area of the dorsal surface of the basioccipital. The *Exoccipital* bones entirely surround the foramen. The basioccipital "door step" is situated outside the plane of the exoccipital door frame. Just before meeting in the mid line the exoccipitals leave the dorsal surface of the basioccipital. The short bony canal thus formed between the dorsum of the basioccipital and the exoccipitals transmits the anterior vertebral artery and vein to and from the cranial cavity.

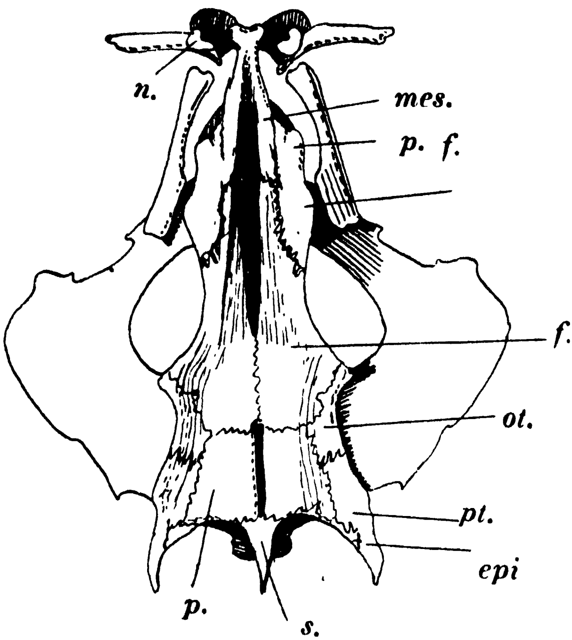

Fig. 3.—*Tandanus tandanus*, dorsal aspect.

Where each exoccipital is reflected off the floor to form the lateral boundary of the foramen it is so reflected as to form a broad shallow gutter, whose floor slopes downward, outwards, and back. The upper limit of this gutter is a spur of bone, which with its fellow of the opposite side determines the centre way of the gothic arch. This "centre way" alone is the foramen magnum (*sensu stricto*). In the fresh state strong membranous bands close the two lateral gutters, converting them into canals separate from the centre way in which the cord lies.

Above and beside the foramen the exoccipital of each side presents a broad expanse of bone on the posterior aspect of the skull. Meeting in the midline above, the two bones form the sides and floor of a groove whose dorsal roof is formed by the base of the supraoccipital crest. To this groove the dorsal spine of the first vertebra is fitted by cartilaginous packing.

The *Supraoccipital* bone contributes the middle two-fourths of the dorsal margin of the skull as viewed from behind. The occipital crest is a flange which arises from the full depth of the bone in the median sagittal plane. As viewed from the side the crest is roughly triangular in outline. The dorsal side of the triangle continues the dorsal line of the skull backward. For the most part suture between exoccipitals and supraoccipital is effected by cartilage, but there is a short true bony suture bridging the gap present in the dried skull between these bones. Above and lateral to the exoccipital the supraoccipital suturates with the opisthotic and epiotic. Along the dorsal margin the sutures are with the parietal medially and pterotic laterally. On either side of the crest the bone is perforated by the foramen of exit of the accessory lateralis ramus of the facial nerve. This foramen is overhung by a relatively heavy flange of the dorsal margin of the bone.

The *Opisthotic* bone, approximately square in outline, fits in between exoccipital, supraoccipital, epiotic and pterotic bones, and contributes to the lower margin of the skull.

The nearly oblong *Epiotic* lies near the dorsal margin, separated therefrom by the pterotic and having the supraoccipital and exoccipital bones to its inner side.

Of the *Pterotic* bone the process alone is seen from behind.

There is a square socket formed at the outer angle of the exoccipital by small flanges of that bone on three sides and the distal end of the epiotic above. This socket is adapted to receive the proximal end of the *Posttemporal.*

The *Basioccipital* bone is of a shape very common among the fishes; it may be compared to a vertebra which has been extended and tapered anteriorly. Inferiorly it is covered to some extent by the synpterygoid, so that rather less than half its antero-posterior length is visible from below; in the mid line, though, on either side of the synpterygoid the bone is visible for its full length. The anterior limit corresponds with the short articulation with the prootic, at the postero-medial angle of that bone.

The synpterygoid extends along nearly the full length of the base of the skull; its forward limit corresponds with the hinder boundary of the tooth-bearing area of the premaxilla in the mid line. The bone is uncovered below except anteriorly, where the median palatine spur-like lamina of the premaxilla lies below it. In the younger specimens the bone is as depicted in Fig. 2, whilst in older specimens it tapers from the widest point backwards to the posterior limit.

Immediately above the basioccipital the exoccipital is placed behind the prootic and below the pterotic and opisthotic. The exoccipital and opisthotic thus have posterior and lateral faces. The foramen of exit for nerves ix and x is very obvious in the centre of the lateral face of the exoccippital.

The *Pterotic* bone is perforated ventral to the root of the spur and just below the posterior end of the hyomandibular sulcus for the transit of blood vessels to and from the bone and perhaps also the contents of the otic capsule.

The *Prootic* is the largest contributor to the side wall of the cranium. Its anterior boundary is deeply notched for the transit of nerves v and vii, and by this notch the suture with the alisphenoid is interrupted.

The *Alisphenoid* suturates with the prootic both above and below the prootic foramen, with the synpterygoid in front of the lower contact, and with the sphenotic in front of the upper contact with the prootic. Immediately above the prootic foramen the alisphenoid contributes three sides to a socket for the anterior end of the hyomandibular bone. In front of the base of this hollow boss the bone is traversed by a canal, which transmits a branch from the trigemino-facial nerve complex. In front of the short contact with the synpterygoid the alisphenoid contributes posterior and superior boundaries to the sphenoptic foramen; the superior boundary is arched and almost reaches the synpterygoid again in front of the foramen. The orbito-sphenoid fills the small interval between the two.

The *Sphenotic* contributes both to the side wall and to the roof of the cranial cavity, situated above the alisphenoid and prootic; it is in contact behind with the pterotic both laterally and on the roof. In front it suturates with the frontal, again both on the roof and laterally. Between frontal and pterotic there is a short suture with the parietal.

The *Epiotic* is a small chip of bone wedged in between pterotic in front and opisthotic below and behind it, and having a short suture with the supraoccipital, as shown in Fig. 1.

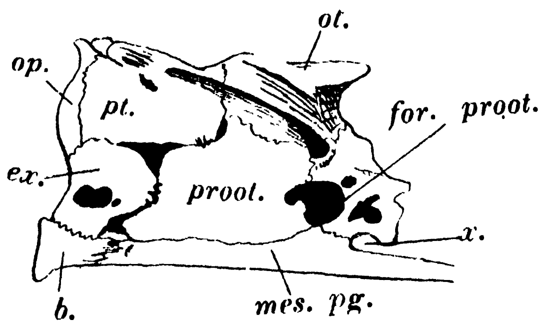

Fig. 4.—*Tandanus tandanus*, side view of cranium.

The bones in the side wall of the cranium are depicted in Fig. 4.

In front of the alisphenoids, between them and the synpterygoid below, the prefrontals in front, and the frontals above, there is a massive spongy bone, bilaterally symmetrical, but possibly developed from two centres. Since it occupies the situation of the two bones which in other fishes (for example, *Amia* and *Salmo*) have been termed orbitosphenoids, and is probably homologous with them, that name is applied here.

The *Orbitosphenoid*, then, is a median bone, quite clearly developed in cartilage. Viewed from above it is roughly oblong, the hinder end being however narrower than the fore end. The ventral margin, as viewed from the side, is straight. The central portion of the ventral surface is furrowed to receive the upper surface of the synpterygoid. From the edge of this furrow each side of the ventral surface slopes upward. Viewed again from the side, it has a straight ventral margin which is the edge of the furrow, and above this the sloping ventral face is foreshortened. It has been already noted that the fore end of the bone is the broader; in consonance with that, the fore end of the ventral surface reaches a higher level than the hinder end. Above the ridge developed along the lateral margin of the ventral surface is a rough vacuolated sulcus, overhung by the outer edge of the area of articulation with the frontal and prefrontal bones. Viewed from above the bone may be described as composed of two massive right and left halves, joined together by a ventral lamina, and having between them a deep furrow or ditch. The massive halves are thickest through from side to side a little forward of the centre of their length. From this point each half tapers both forward and backward. In front the tapering is but slight, and there is a bluff truncated fore end to each half. Behind the broadest point the solid

side walls of the ditch taper to nothing. The ditch is therefore broad and open behind, and narrow but still wider in front than it is near the mid point of its length. Since the lateral masses are deepest dorso-ventrally at the point where they are thickest, here also the ditch is deepest. In front of this point the full height of the walls is maintained for a very short distance, and then there is an abrupt truncation, with a very slight inclination forwards as well as down. Behind the highest point the wall is lowered gradually for an interval, is then almost vertically truncated for half its height, continues at that height a little way, and then is brought to floor level by a second step. At the narrowest point the ditch is V-shaped in vertical section. Behind and in front of this point the *floor* of the space is V-shaped. Behind the narrowest point it is as though the two arms of the V had been separated further and shortened. In front of the narrowest point the contours are somewhat different, the side walls diverging as do those at the back, but there is a bulge inward, which begins at the floor at the narrow point, becomes more marked as it passes forward, and rises to just above the middle of the height at the forward end.

Posteriorly the space between the walls merges with the cranial cavity; anteriorly the divergent walls permit the olfactory peduncles, which lie upon the floor of the cavity, to pass right and left towards their respective capsules. The broad dorsal edge of the massive side pieces are in contact by suture with the sphenoidal ridge of the frontal and with the prefrontal. A very obvious pit divides the frontal area behind from the prefrontal area in front. With the bones in situ it is found that the sphenoidal ridge of the frontal is notched on the outside to permit the transmission of a vessel towards this pit, and that, on the inside, a bigger foramen interrupts the suture just behind the pit; doubtless nutrient vessels alone pass this way. Suture between the orbitosphenoid and prefrontal is largely effected per medium of cartilage; there is however a small true sutural contact at the fore end of the lamina delimiting the lateral border of the sloping ventral surface, and also just in front of the frontal area of suture.

The *Frontal* bone presents little of interest; of a common shape it suturates with its fellow of the opposite side, and with parietal, sphenotic, alisophenoid, orbitosphenoid, and prefrontal. It roofs the orbit and contributes to the roof and side wall of the cranial cavity; this latter per medium of a low sphenoidal lamina, which articulates with alisphenoid and orbitosphenoid. At a point a little in front of the situation of the sphenoptic foramen, the underside of each frontal presents a broad ridge of low elevation. This may be regarded as the forward limit of the true cranial cavity. It corresponds to an abrupt narrowing of the cavity, clearly indicating its forward limit; this is found in many fish skulls. Forward of this ridge the central portions of the frontals and the sphenoidal laminae contribute to the roof and side walls of a cavity whose remaining bony walls are supplied by the orbitosphenoid. Just a little way in front of the low ridge above

described, the frontal bones diverge from the mid line leaving a fontanelle which in the fresh state is filled by tough fibrous tissue and covered by the skin. The anterior portion of the roof of the orbit is much thickened; the thickening ceases abruptly and gives place to a rough surface for articulation with the prefrontal. Forward of this the bone tapers and becomes thinner, overlying the prefrontal. Cavities between the two bones, present in the dry state, are in the fresh filled by hyaline cartilage.

The *Prefrontal* bone supplies a solid triangular boss to the front of the bony margin of the orbit. Its position beneath the narrowing fore end of the frontal has already been described. Its outer margin is arcuate, and it terminates in front and laterally in a second prominence, not so marked as the orbital, to which the maxilla is attached by a short stout pedicle of fibro-cartilage. There is rather more of the dorsum of the bone exposed than is covered by the frontal. In front of the area covered by this last bone there is a small area covered by the corresponding dorsal arm of the mesethmoid. In front of and below this and to the inner side of the roughened area which gives attachment to the maxilla, is an area which gives attachment to hyaline cartilage which fills the gap here present between this bone, the mesethnoid, and the dental plate of the premaxilla. To the outer side of this area, in front of that which gives attachment to the maxilla, there is a very short true suture with the outer corner of the dental plate of the premaxilla.

The front of each prefrontal is hollowed out; the cavities they contribute to will be discussed later, together with certain canals and cavities in the bones.

The *Mesethmoid* is composed of a body and three prongs. Two of the prongs are dorsal and subdermal in position. Each suturates with a small area on the antero-medial and dorsal corner of the corresponding prefrontal, covering this area and extending back to interdigitate with the fore end of the frontal of the same side. The body of the mesethmoid, approximately cylindrical, tapers anteriorly and terminates in a laterally expanded and down turned triangular spatulate plate. The third prong, median in position, extends back from the ventral aspect of the body to interdigitate with the fore end of the synpterygoid.

There are three fontanelles in the roof of the younger skulls and two in the older. The posterior sagittal fontanelle is between the parietal and hinder end of the frontal bones. The anterior sagittal is between the fore end of the frontal bones. The intra-mesethmoid fontanelle lies between the two dorsal prongs of the mesethmoid bone. In adult specimens the posterior sagittal fontanelle is closed. In some cases the two anterior fontanelles are continuous, in others suture between the extreme tips of the frontal bones separates them.

The fore end of each prefrontal is hollowed out. When the two bones are in situ these recesses are opposite and open towards one another. In the intact skull a cartilaginous septum is present between them. Dorsally this septum sends a lamina out horizontally to line a narrow area of the roof of each cavity. The septum commences behind about the centre of the length of the intra-mesethmoid fontanelle, and with its dorsal outspread flanges is continued forward to the hinder face of the body of the mesethmoid. Since the under surface of the dorsal prongs and upper surface of the ventral prong of the mesethmoid approach one another anteriorly, it follows that this septum decreases in height as it passes forward. Ventrally the septum is planted on a broad sheet of cartilage which extends from one prefrontal recess to the other, filling the interval between prefrontal and synpterygoid, clothing the upper surface of that bone and extending back to reach the fore end of the floor of the orbitosphenoid. Continued forward this sheet of cartilage covers the upper surface of the ventral arm of the mesethmoid and a small area of the premaxilla on either side. Anteriorly dorsal and ventral cartilaginous laminae become continuous with the cartilage already described as filling the gap between prefrontal, mesethmoid, and dental border of the premaxilla.

There are thus formed here two conical cavities divided from one another by a common septum. Posteriorly the roof, side wall, and a small portion of the floor are formed of bone, the bone being prefrontal. For the rest the floor is carpeted with cartilage throughout, and anteriorly where bone is wanting the side walls are of the same tissue. Posteriorly the cavities are open to the sphenoidal cavity on either side of the abruptly truncated septum. Anteriorly each capsule terminates around a foramen which interrupts the premaxillo-mesethmoid suture. The olfactory peduncle enters each capsule at the back along the floor from the sphenoidal cavity; together with accompanying blood vessels it terminates in the small olfactory bulb.

The incomplete posterior bony wall provided by the prefrontal is perforated by the anterior opening of a canal which transmits the artery to the olfactory bulb from the orbit. The orbital opening of this canal is situated above the fore end of the sulcus on the orbitosphenoid formed by the flange on the edge of the sloping ventral face. There is a larger opening to the inner side of it, leading into a canal (*canalis nervo tentaculi medialis*) whose outer end is on the dorsal surface near the anterior end of the bone; it transmits a nerve (*ramus opth. superfic. trigemini*) and blood vessels. Towards the anterior end this canal suddenly dilates into a small rounded chamber. It has not been possible to examine the contents of this chamber, but it is believed that a ganglion is here present.

Sphenoidal cavity. This name is applied to the continuation of the cranial cavity beneath the frontal bones and their sphenoidal lamina, and above the orbitosphenoid.

Clearly the forward limit of the true *cavum cerebrale* is in the situation previously indicated. As stated above this point corresponds to an abrupt narrowing of the cavity in many fish (for example *Epinephelus*). In those forms (for example *Sebastodes*) in which an inter-orbital septum is developed, the olfactory peduncles quite obviously leave the cranial cavity at this point and continue forward on either side of the septum. In the majority of birds this point is recognisable as the cribriform plate or olfactory foramen, the peduncles continuing forward on either side of the inter-orbital septum as in *Sebastodes*. In the majority of reptiles, the condition is as in *Epinephelus*, but in some of the chelonians the resemblance is rather to *Tandanus*. Among the birds it appears that in the rhea and in the toucan the upper end of the intorbital septum divides to form one or two bony canals for the olfactory peduncles.

It is apparent then that in some fishes, all (?) reptiles, and some birds there is a cavity continuous behind with the cranial cavity, in which are lodged the olfactory peduncles; it is equally apparent that this cavity cannot be regarded as portion of the true cranial cavity. It has therefore been termed the sphenoidal cavity.

Turning our attention next to the floor of the cranial cavity, we have first to define the basisphenoid. On viewing the side wall of the cavity from within, the articulation of the alisphenoid with a short stout pedicle rising from the floor between optic and prootic foramina, immediately attracts attention in the present connection. This is the situation in which in the typical piscine skull the transverse arm of the basisphenoid articulates with the alisphenoid. This articulation of the alisphenoid below the *foramen prooticum* has previously been described from outside as with the synpterygoid, and that is justified, because no trace of discontinuity in bone structure can be found in this view between the suture and the midline where unquestionably the bone is synpterygoid. It is true also that in many fishes there is an upflung spur of the synpterygoid in this region which articulates with the alisphenoid, but in these cases, as in all that I have been able to inspect, the identity of the bones is placed beyond cavil by the presence of an eye muscle canal. In the present case as viewed from within, the suture is between an unquestionable component of the cranial floor and the alisphenoid. By carefully disarticulating a young skull the orbitosphenoid may be freed from the synpterygoid just in front of the optic foramen, but must be broken from the thin bone forming the floor behind it. Again the prootic and exoccipital may be separated from the synpterygoid and from their fellows of the opposite side, but must be broken from the thin bony floor in front. Except actually between the pedicles the floor is exceedingly thin, and there is a definite space between it and the underlying synpterygoid. The area between the pedicles and for a little way both in front and behind them is either basisphenoid or it is synpterygoid. But the synpterygoid (our old friend the parasphenoid) is a ventral covering

All the cavities are shallow from above down; the anterior pair commence just where the pedicles of the basisphenoid begin to lift above the level of the cranial floor. Here they are but small nearly circular canals; passing forward they very rapidly expand laterally, and come to underlie nearly the whole width of the cranial floor between the two sphenoptic fissures. At the transverse level of the anterior boundary of those fissures, the space enters the substance of the orbitosphenoid, and again narrowing from side to side terminates before the narrowest portion of the sphenoidal cavity is reached. A most careful examination of several disarticulated skulls has failed to reveal any definite foramen or canal connecting either of these cavities with the cranial cavity or the orbit. The roof and side walls of the space are demonstrably constituted by the basisphenoid behind and by the orbitosphenoid in front. Where the cavity extends into the orbitosphenoid, although confined to the area above the synpterygoid, that bone does not contribute to the floor, there being a very definite floor formed by the orbitosphenoid. This floor comes away with the bone when the skull is disarticulated, so that with the orbitosphenoid alone in hand one may study the shape and constitution of the anterior portion of the cavity. In the region of the basisphenoid that bone and the synpterygoid are intimately fused, and cannot be disarticulated. It is therefore not possible to assert that this or that bone forms the floor, but appearances support the belief that it is formed by the synpterygoid.

The posterior cavities commence in front immediately behind the front pair, separated by a narrow but solid bony partition. They broaden very rapidly and then narrow slightly again, proceeding back on either side of the mid line. The septum dividing them terminates abruptly at the level of the auditory hiatus, so that the cranial floor behind this level roofs a cavity which extends uninterruptedly from side to side. As the cranial floor becomes narrower as the basioccipital is reached, so also does the underlying cavity. Its terminal portion is truly conical, lies beneath the exoccipital component of the cranial floor, and excavates the body of the basioccipital. One definite opening and one only has been detected whereby structures within this larger posterior cavity may become continuous with others without. This single opening is a fissure on the left side of the centre, and through it passes a blood vessel. But inasmuch as there is no other foramen or canal of appreciable size opening into the cavity one is forced to conclude that the blood vessel is a nutritive one entering the cavity rather than issuing from it.

In the *Palate* and upper jaw there are features of particular interest.

The *Hyomandibular* has a rather longer line of attachment than is the rule, and at the forward end the attachment is further strengthened by the development of a spur which fits very nicely into a socket on the alisphenoid just above the prootic foramen. This spur

forms the lower end of a low ridge which crosses the bone directly away from the skull. As is common the bone is traversed by a branch of the mandibular nerve. The canal for this nerve commences as a groove behind the ridge just described; half way across the bone it becomes completely enclosed, and its distal opening is into an interruption of the hyomandibular-symplectic suture, so that it may be said to open upon both ventral and dorsal surfaces. There is a well developed face upon the posterior margin for articulation with the preopercle.

The *Quadrate* calls for but brief mention. Rhomboid in outline it is firmly held in place by an interdigitating suture with the symplectic, and connected to the hyomandibular by cartilage, so that in the dried skull there is a marked gap between the two.

The arcuate *Symplectic* is as firmly sutured to the upper end of the posterior margin of the hyomandibular as it is to the quadrate.

In the typical piscine subocular arch there are in front of the quadrate four bones, in *Tandanus* as in some other siluroids there are but three.

The flattened elongated bone in front of the quadrate is sutured also to the outer anterior corner of the hyomandibular, and in front it is attached by fibrous tissue to the rough side of the orbitosphenoid. To the outer side of this attachment there is a small bone sutured to that just mentioned and attached by fibrous tissue to the hinder border of the alveolar plate of the premaxilla.

Attached to the dorsal face of these two bones just where they are sutured together is the hinder swollen end of a rod of bone, which, passing forward, is attached by a fibro-cartilaginous pedicle to the outer anterior angle of the prefrontal. Continued forward this rod provides a point of attachment for the labials of its side.

Though metamorphosed somewhat, that portion of the rod of bone which projects to provide support for the labial bones, is recognisable beyond doubt as the forward projecting strut so very constantly present in the maxilla of other fishes, and there also providing support for the labial bones. The attachment to the prefrontal by fibro-cartilage is a further feature which confirms the identification of this rod of bone as the maxilla.

As an aid to the identification of the two bones between the quadrate and premaxilla, the subocular arch and suspensory bones of *Brosmius brosmius* have been drawn. The usual number of bones are here present; the *os transversum* is very much reduced, the quadratojugal expanded and plate like, the palatine reduced, and the reduced and toothless maxilla continued forward into a labial strut rather longer than is usual.

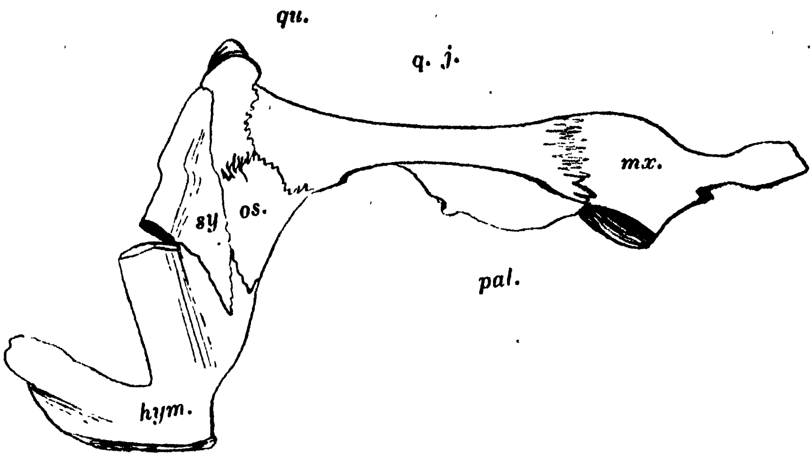

Fig. 5.—*Brosmius brosmius.* Right suspension and subocular arch viewed from below.

It will be at once apparent that in the neighbourhood of the quadrate the posterior of our two doubtful bones corresponds only to the quadrato-jugal. The *os transversum* is pretty certainly absent, and the small bone in front must be the palatine. Apparently the weakening of the palatal arch, which occurred with the loss of the support afforded by the intimate and rigid suturing of the maxilla to the other elements, has in this case been compensated by the expansion of the quadratojugal medially and its attachment to the orbitosphenoid, the palatine being thereby given a position apparently to the outer side of the quadratojugal.

The *Premaxilla* is composed of a heart-shaped or triangular dental plate and a spur-like palatine lamina projecting back from the hinder border thereof. The dental plate fits on to the lower surface of the ventral prong of the mesethmoid. The apex of the triangular plate is anterior in situation and lies upon the ventral face of the body of the mesethmoid, just behind the centre of its length. The palatine lamina lies below and in contact with the hinder moiety of the ventral prong of the mesethmoid and the fore end of the synpterygoid.

The *Premaxillary Labials* have an elongated triangular dental plate from the posterior margin of which a "nasal" lamina rises upwards and backwards when the bones are in situ. The two maxillae are attached by fibrous tissue to the edge of the down turned spatulate terminal plate of the mesethmoid. The attachment is to the inner third of the front margin of the dental plate and the dorsal surface of the bone above. The two bones are also attached to one another by fibrous tissue along the narrow side of the triangular dental plate, this attachment being of course in the mid line.

The *Maxillary Labials* are insignificant arcuate rods of bone attached at their inner end, behind to the maxilla, ventrally to the nasal lamina of the maxillary labial, and in front to the nasal bone. The distal half of the bone is free and projects out and back, continuing the line of the front margin of the premaxillary labial.

The Nasal is a small rhomboidal scale of bone, which is hung between the inner half of the maxillary labial above and behind it, and the outer half of the front margin of the premaxillary labial in front.

The arrangement of these bones in the snout is such that an incomplete bony capsule is formed on either side of the fore end of the mesethmoid. Of this capsule the floor is complete and is formed by the upper surface of the premaxillary labial. The front wall, wanting medially, is supplied by the nasal. The roof, formed by the inner half of the maxillary labial, slopes rapidly laterally, and therefore forms the outer wall. The posterior wall is supplied by the nasal lamina of the premaxillary labial. It would perhaps have been more truly descriptive had this "nasal capsule" been described as a bony trough supplied with complete walls and roof in its outer half. The portion of the capsule enclosed by soft tissue is perforated by the nasal apertures in front and by the nerves and blood vessels behind.

The foregoing description is based on a fine range of heads obtained for me by Mr. J. S. Caldwell, Inspector of Fisheries, to whom my thanks are due.

With two exceptions the descriptions of the relations of the bones to one another have been verified by actual disarticulation. None of my specimens were young enough to enable me to disarticulate synpterygoid from basisphenoid or parietals from supraoccipital. The mode of determining the extent of the fusion in the first case is already stated. My youngest specimen, a little younger than that figured, and the specimen figured, show what I am confident are sutures as indicated in the drawing. The verity of these sutures is however questioned by the fact that Koschkaroff[4] describes large dorsal laminae for the supraoccipital, and terms the bones in front thereof "fronto-parietals" in all the siluroid skulls dealt with in his memoir. Schelaputin[5] similarly describes and figures the bones in *Clarias*. Had I not these two young skulls of *Tandanus* I should in like manner have failed to find parietal bones. Maybe I am in error, but I believe that had Koschkaroff and Schelaputin had younger material they would have described them as I have done. At a later date I hope to confirm or correct my description.

[4] Koschkaroff—Bull. Soc. Imp. Nat. Moscou, xix, 1905 (1906), pp. 209-307.
[5] Schelaputin—Op. cit., pp. 85-126.

The palatine of my description is present in several of the siluroids described by Koschkaroff, notably *Akysis* (*fig. 21, p. 237, Os. d*) but is deemed by that writer to be merely an ossification in fibrous tissue, though he admits a semblance to a "*pterygoid*" (*p. 244*).

I have to admit that though I have applied the name symplectic to a bone in the previous description, I have been unable to entirely satisfy myself that the bone in question would not be more correctly termed preoperculum as is done by Koschkaroff and other writers. Whilst of the opinion expressed I leave the question *sub judice*.

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Index to abbreviations used in the drawings:—

b.	*basioccipital*
epi.	*epiotic*
ex.	*exoccipital*
f.	*frontal*
for. proot.	*foramen prooticum*
hym.	*hyomandibular*
lab. 1.	*premaxillary labial*
lab. 2.	*maxillary labial*
mes.	*mesethmoid*
mes. pg.	*synpterygoid.*
mx.	*maxilla*
n.	*nasal*
op.	*opisthotic*
orb.	*orbitosphenoid*
os.	*os transversum*
ot.	*sphenotic*
p.	*premaxilla*
pal.	*palatine*
proot.	*prootic*
pt.	*pterotic*
q.j.	*quadratojugal*
qu.	*quadrate*
s.	*supraoccipital*
sph.	*alisphenoid*
sy.	*symplectic*
x.	*sphenoptic foramen*

AUSTRALIAN NYCTERIBIIDAE.

By

A. Musgrave, F.E.S., Entomologist.

(Plates xliv-xlv.)

Only four species of Nycteribiidæ have hitherto been recognised from Australia, and to these I add a fifth which appears to be new. As the bat fauna of Australia is large, this number should certainly be increased in the future, for the group has been somewhat neglected owing to lack of material due to the failure on the part of mammal collectors to secure the parasites. Of recent years, however, the importance of securing animal parasites with all particulars has been fully realised by Mr. E. Le G. Troughton, Mammalogist of the Australian Museum, to whom I am greatly indebted for his efforts in securing material for me.

In 1901 Speiser[1] described a male Nycteribid, parasitic on *Chalinolobus gouldi* Gray, collected at Smithfield, N.S. Wales. He identified it as *Nycteribia oceanica* Bigot[2], a New Caledonian species from an unknown host. Falcoz[3] has since pointed out that the description given by Speiser could not apply to Bigot's species, the true *oceanica* possessing ocelli and showing a remarkable reduction of the ctenidium (14 teeth in that of the male) while in Speiser's specimen the eyes are absent and the ctenidium is well developed (60 teeth). As Falcoz omitted to suggest another name for Speiser's species, and as this institution is fortunate in possessing specimens which agree with Speiser's description, I here propose to describe the species as new, figure the male and female, the latter being quite unknown to Speiser.

In 1904 Rainbow[4] added a new species *Nycteribia pteropus*, a parasite of the Flying-fox *Pteropus gouldi* Peters from the Gulf of Carpentaria. He erroneously believed it to be the first Nycteribid to be made known from Australia, and being unable to refer to Speiser's monograph of the group failed to place it in its correct genus. According to Speiser's key *pteropus* enters the genus *Cyclopodia*, having three oblique white bands on the tibia. The species has been recently characterised and refigured by Ferris[5] as *Cyclopodia pteropus*, but that author questions its specific status, and suggests that it cannot be separated from *C. similis* Speiser.

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[1] Speiser—Arch. Naturg., lxvii, 1, 1901, p. 41.
[2] Bigot—Ann. Soc. Ent. Fr. (6), v, 1885, p. 246.
[3] Falcoz—Nova Caledonia, iii, 1923, p. 86.
[4] Rainbow—Rec. Austr. Mus., v, 1904, p. 78, pl. ix.
[5] Ferris—Amer. Mus. Novit., No. 110, 1924, p. 5, f. 5.

In 1914 Scott[6] published a description and figure of *Nycteribia* (*Listropodia*) *parilis* Walk.[7], a species originally made known from the Moluccas. He identified as this species a dried male specimen in the British Museum which was labelled as taken from an Australian bat, *Miniopterus australis*, and presented by Mr. Tomes. This was the third species to be recorded from Australia.

In 1923 Falcoz[8] recorded the fourth species, *Nycteribia* (*Listropodia*) *sarasini* Falcoz from Mossman, Queensland.

In drawing up the description of the following species I have followed the plan adopted by Scott[9]. I agree with him that until we have a wider knowledge of the family than we possess at present, and a clearer understanding as to the limits of the genera, full and detailed descriptions are necessary. This will account for the long description of the species below.

To Mr. A. R. McCulloch, Zoologist of the Australian Museum, I desire to express my indebtedness for advice and assistance, to Mr. Tom Iredale for much valuable help with problems of nomenclature, and to Miss Joyce K. Allan for preparing some of the figures. Dr. E. W. Ferguson has kindly perused the manuscript and made useful suggestions.

Genus NYCTERIBIA *Latreille* 1796.

Subgenus NYCTERIBIA *Latr.* 1796.

Nycteribia Latreille, Précis Caractères Insectes, 1796, p. 176.
Haplotype.—*N. vespertilionis* = *Acarus vespertilionis* Fabr = *Pediculus vespertilionis* Linn.

Phthiridium Hermann, Mém. aptérolog., 1804, p. 120.
Logotype.—*Phthiridium vespertilionis* = *N. vespertilionis* Linn.

Acrocholidia Kolenati, Wien. Ent. Monats., i, 1857, p. 62 ? (nomen nudum); Horae Soc. Ent. Ross., ii, 1862, p. 60.
Logotype.—*Acrocholidia montagui* Kolenati = *N. vespertilionis* Linn.

Nycteribia was proposed by Latreille for a single species, which he identified as Linné's *Pediculus vespertilionis* apparently on the basis of Fabricius's work, and he gave a short diagnosis of the genus. Linné's[10] *Pediculus vespertilionis* was briefly described and a reference given to a poor figure by Frisch. The description applies to a member of this genus, and nearly every author has regarded the species, later

[6] Scott—Ann. Mag. Nat. Hist. (8), xiv, 1914, p. 231, pl. xii, f. 20-23.
[7] Walker—Journ. Linn. Soc. Lond., Zool. v, 1861, p. 300.
[8] Falcoz—Loc. cit, iii, 1923, p. 89, figs. 9-12.
[9] Scott—Loc. cit, p. 210.
[10] Linné—Syst. Nat. Ed. x, 1758, p. 611.

named *vexata* West[11], and *montagui* Kol., as the equivalent, but latterly it has been the custom to discard Linné's name in favour of recent ones. I can see no reason for dismissing Linné's name, as a great deal of confusion would ensue if this action were logically followed out, the elimination of the family and generic names being anticipated. As a matter of fact Kolenati did get rid of the subgenus *Nycteribia*, and he has been unthinkingly followed by later workers such as Speiser, who has admitted three subgenera of the genus *Nycteribia*, namely, *Acrocholidia*, *Stylidia* and *Listropodia*. *Phthiridium* was introduced independently for the same group by Hermann, the logotype being *P. vespertilionis*. The name becomes an absolute synonym of the typical *Nycteribia*. Kolenati's *Acrocholidia* was used for the same series, and is consequently exactly synonymous.

Subgenus CELERIPES *Montagu* 1815.

Celeripes Montagu, Trans. Linn. Soc. Lond., ix, 1808, p. 166 (nomen nudum); op. cit., xi, 1815, p. 11.

Haplotype.—*C. vespertilionis* Montagu (? not Latreille) = *Phthiridium biarticulata* Hermann.

Stylidia Westwood, Introd. mod. classif. Insects, ii, 1840, Synops. Genera, p. 154.

Haplotype.—*S. biarticulata* Hermann.

Celeripes was introduced by Montagu as a *nomen nudum* in 1808, and in 1815 he described the insect under the genus *Nycteribia*, but cited his *Celeripes* in the synonymy, this according to the International Rules establishing its validity, and it must replace the twenty-five years later *Stylidia*, the haplotype in each case being the same species.

Subgenus LISTROPODA *Kolenati*, 1857.

Listropoda Kolenati, Wien. Ent. Monats., i, 1857, p. 62.

Logotype.—*L. latreillei* Leach.

Listropoda is the spelling given by Kolenati at the introduction of the name; later he used *Listropodia*, whether by accident or design is unknown, so we must revert to the earlier usage. Latreille's[12] *Nycteribia pedicularia* was proposed purely as a new name for Linné's *Pediculus vespertilionis*, and therefore passes into the synonymy of the Linnean species, and cannot be used in place of Leach's *latreillei* as has been done by Speiser.

[11] Westwood—Trans. Zool. Soc. Lond., i, 1835, p. 291.
[12] Latreille—Hist. Nat. Crust. et Insectes, xiv, 1805, p. 403.

A Key to the subgenera of the genus *Nycteribia,* based on that of Speiser, is here given:—

Key to Subgenera of *Nycteribia.*

A. Tibia of the usual form, not expanded outwards.
   a. Anal segment of the ♂ conical, more or less tapering to a point, that of the ♀ being without appendages upon its dorsal surface. *Nycteribia.*
   b. Anal segment of the ♂ stout, conical with a very blunt end, that of the ♀ dorsally with a pair of longer styloid processes and long, bristly appendages at the end. *Celeripes.*

B. Tibia expanded laterally, so that in the anterior legs of some species they are almost as broad as long. *Listropoda.*

Subgenus NYCTERIBIA *Latreille.*

NYCTERIBIA FALCOZI *sp. nov.*

(Pl. xliv and Pl. xlv, figs. 5-7.)

(?) *Nycteribia* (*Acrocholidia*) *oceanica* Speiser (not Bigot) Arch. Naturg., lxvii, i, 1901, p. 41.

Length. 2.2 to 2.5 mm.

Colour. Specimens in spirit light brown. Type specimens, mounted in Canada balsam, light yellowish.

Head bare, with the exception of some moderately long bristles on the vertex and some shorter ones along the margins of the cheeks. Along the inner and outer sides of each maxillary palp is arranged a row of bristles, those on the outer side appearing to spring from the margin while the inner ones are nearly all placed well inside the margin. Near the bases of the first bristle of the outer row and the second bristle of the inner row at the anterior end, is a long bristle, while at the extreme end of the palp is a much longer and stouter bristle. Variation exists in the number of bristles in the rows on the palps, though the two long bristles appear to be always present though not constant in position.

Thorax beneath nearly as long as broad, almost flat, surface covered with minute bristles, with a median furrow widened behind and terminating in a depression. Along the hind margin is a fringe of six long bristles, three on either side of the middle line, those on the outside being the longest. Interspersed among these are smaller bristles.

The bristles on the dorsal surface in front of the halteres pits are stated by Speiser to vary in number from 12 to 13 in the male. In three males examined the bristle formula reads as follows:—

Register Number.	Left.	Right.
K48158	13	10
K48160	12	13
K48161	12	12

Five females examined show an even greater departure from the number given by Speiser, namely:—

Register Number.	Left.	Right.
K48162	12	12
K48163	11	10
K48164	9	10
K48165	14	12
K48159	13	13

Front coxa twice as long as broad, not one and a half times as stated by Speiser, covered with bristles, those on the posterior margin being longer and stouter than the others.

Femora. Front pair with their anterior surfaces bearing numerous short bristles, the posterior surfaces bare. Middle pair with their anterior surfaces bearing bristles, the proximal dorsal portions being almost devoid of them, while ventrally the posterior surfaces are bare. Hind pair with their anterior surfaces bearing bristles only at their distal extremities, the proximal dorsal portions being bare, though a few short dark bristles form a single row towards the posterior surface, while ventrally a row of bristles extends the length of the femur. The ring on each femur usually bears on its proximal side a row of bristles, those on the ventral aspect of the hind femora being more noticeable. From the end of each femur near its junction with the tibia spring two moderately long bristles.

Tibiæ. Three long erect bristles spring from the upper surface of each tibia, one, the longest, situated near the base, one about the middle, and one in front of the distal end. Ventrally and towards the distal portion are three rows of bristles. In each of these, is a pair of short dark bristles, those of the last pair being larger, and extending almost as far as the apex. Anterior surfaces bare. The metatarsi appear to be half as long as the tibiæ.

Abdomen ♂ (Dorsal aspect). (Pl. xliv.) *Basal tergite* small, trapezoidal, and bearing a number of short bristles, the anterior margin sinuate. The suture separating the tergite from the following one is not clearly defined. *Tergite* 2 bearing three irregular rows of very short bristles towards the anterior margin, and densely pubescent at the posterior angles. From the posterior margin springs a series of long bristles extending to the border of the following tergite, and alternating with each pair of these is a single very short bristle. *Tergite* 3 bare, except for two irregular rows of very short bristles situated about the middle of the tergite. On the posterior border the long hairs are of unequal length and interspersed with from one to three thorn bristles. *Tergite* 4 bare, except for an irregular row of short hairs, and on the posterior margin the long hairs extend well beyond the posterior margin of the following tergite, while the thorn bristles towards the middle are fully twice as long as those of the other tergites. *Tergite* 5 resembles the preceding. *Tergite* 6 bare on the disc. On the posterior margin the long hairs are less numerous than

in the preceding tergites, while two of the most median are much longer than the others and extend more than half way down the anal segment. *Anal segment* long, bare towards the anterior margin, otherwise covered with short bristles, fairly evenly spaced and with two moderately long, erect bristles in the apical third. At the sides are erect bristles, and from each of the posterior angles spring two long bristles and three shorter ones.

(Ventral Aspect) (Pl. xlv, fig. 5). *Basal sternite* with middle line slightly furrowed, the surface with four irregular rows of short bristles. The ctenidium has about 50-60 spines. *Sternites 2 and* 3 have their posterior margins beset with fairly long bristles, which vary somewhat in length, those at the sides being much longer than those in the middle. The discs bare, except for a few bristles toward the lateral margins. *Sternite* 4 slightly longer than the preceding together. Hind margin curved, bearing in the middle short stout thorn-bristles arranged in two rows, one on the margin of 12, the other, in front, of 10 bristles, though these numbers are liable to considerable variation. Other bristles of different lengths extend on either side of these, and in front of the marginal series is a row of semi-erect bristles. *Anal segment* with a number of erect hairs at the sides and at the posterior end. Claspers strong, extending to the posterior margin of *sternite* 4, slightly separated, with their apices directed inwards and downwards. On the outer side of each clasper are some short slender bristles directed outwards, and towards the base are some short bristles, and one, very long and strong, directed downwards.

Abdomen ♀ (Dorsal aspect) (Pl. xlv., fig. 6). *Basal tergite* trapezoidal, small and not reaching to the sides of the abdomen, its hind margin deeply and widely sinuate, and bearing on either side of the groove a row of five large (sometimes four) and three small bristles, of which the most median are the longest. At the sides of the disc are short bristles, while the middle is bare. *Tergite* 2 is long, and in appearance somewhat resembles that of *Nycteribia* (*Acrocholidia*) *fryeri* Scott[13]. It is subcordate in form and is divided longitudinally into two halves by a faint wavy line. Each side is convexly curved anteriorly and concavely sinuate posteriorly, the hind margins being acuminately produced. Each hind margin bears two long, sometimes three, stout bristles similar to those borne on the hind angles of the basal tergite, and six to seven small thorn bristles. On either side of the dividing line are some scattered short bristles, and about midway on each of the lateral borders of the tergite are three, sometimes four, longer bristles, while a few bristles spring from the anterior angles. On either side of the tergite, particularly towards its posterior end, is an area of connexival membrane bearing a number of minute bristles. Beneath the acuminately produced hind margins of the tergite, and connected on either side with the connexival membrane, is a chitinised area carrying on its rounded hind margin four to six moderately long bristles, arranged in groups of two or

[13] Scott—Trans. Linn. Soc., Lond. (2), Zoology, xvii, 1914, p. 164, f. 1.

three at each of the lateral angles. *Anal segment* short and tapering slightly, its surface bare. The hind margin is emarginate and from its hind angles are given off a group of two long bristles, while smaller bristles occur along the margin itself.

(Ventral Aspect) (Pl. xlv., fig. 7). The abdomen is deeply indented at the sides from the third to the fourth tergite, due to the collapse of the connexival membrane. *Basal sternite* as in the male. *Sternite* 2 bears on its hind margin a series of moderately long bristles. *Sternite* 3 short, its surface bare, but on the hind margin there is a series of bristles resembling those of the preceding sternite, but spaced further apart. At the sides, the sternite is not so broad as *sternite* 2, owing to the collapse of the connexival membrane as stated above. *Sternite* 4 closely resembles the preceding, but is broader and bears some long hairs at the sides. *Sternite* 5, is very much longer and bears two rows of bristles, one on the hind margin resembling those of the other sternites and with one to two long bristles at the sides, while the second row is situated close in front and consists of much smaller bristles. *Subgenital plate* broad, membranous, bare, bearing towards the posterior end on the disc a row of short bristles. Between this row and the hind margin are situated two sub-erect bristles. The hind margin is rounded, with a row of fourteen bristles, the two on the outer sides being long, and resembling those at the sides of *sternite* 5. A few short bristles occur on the sides.

Host.—Gould's Bat, *Chalinolobus gouldi* Gray.

Hab.—S. Australia: Mt. Lyndhurst, 30 miles East of Farina, December, 1919, seven males and five females collected by Mr. E. Le G. Troughton, Mammalogist to the Australian Museum.

Types.—The holotype, allotype, and paratypes are in the Australian Museum. Four paratype males are preserved in alcohol, while the remaining eight specimens of the series are mounted in Canada balsam. Holotype, register number K.48158, Allotype, register number K.48164.

Note.—It is to be understood that the new name shall apply strictly to the type specimens in our collection, and not to the material on which Speiser based his description of *oceanica*. This precaution, I trust, will prevent any confusion arising in the event of Speiser's specimen later proving to be distinct from the new form with which I now associate it.

NYCTERIBIA BREVICAUDA *n. sp.*

(Pl. xlv, figs. 1-4.)

Length 2 to 2.3 mm.

Colour brownish (specimens mounted in Canada balsam), more strongly pigmented than the preceding species.

Head with a few long bristles on the vertex, and some shorter ones along the anterior margins of the cheeks, otherwise smooth.

Thorax beneath nearly as long as broad; of the three specimens measured with a micrometer rule, two males have the thorax nearly 1⅛ times as broad as long while one female has the thorax nearly 1¼ times as broad as long. The surface is covered with minute bristles, which appear longer than in *N. falcozi*. Median longitudinal suture broadened behind the middle and terminating in a depression. Along the hind margin is a fringe of six long bristles, three on either side of the middle line, while interspersed with these are shorter ones. On the dorsal surface the bristles in front of the halteres pits vary in number. Thus in the two males and one female examined the bristle formula reads as follows:—

Register Number.	Left Side.	Right Side.	Sex.
K49848	12	12	♂
K49849	9	9	♂
K49850	13	15	♀

Legs.—Front coxa twice as long as broad, provided with stout bristles, otherwise the legs closely conform to those of *N. falcozi.*

Abdomen.—♂ (Dorsal aspect) (Pl. xlv, fig. 1). *Basal tergite* small, trapezoidal, bearing two groups of bristles one at each of the lateral angles, anterior margin sinuate. *Tergite* 2 bearing two irregular rows of bristles near the anterior margin and a number of spines at the posterior angles. From the posterior margin springs a row of long bristles extending to the border of the following tergite, except at the posterior angles, where they extend only about half way to the border. Projecting between each pair of long bristles, particularly towards the centre of the border, is a single minute thorn bristle. *Tergite* 3 bare. From the centre of the posterior border the long hairs extend on to the following tergite and may be interspersed with one to two thorn bristles. *Tergite* 4 bare; the long bristles springing from the middle of the posterior margin are much longer than those of the preceding tergites and extend some distance beyond the margin of the following tergite. The single thorn bristles which alternate with them are twice as long as those of the other tergites. *Tergite* 5 bare, with very long hairs and stout thorn bristles. *Tergite* 6 bare. On the posterior margin the long hairs are less numerous; two of the most median extend almost the full length of the anal segment. *Anal segment* short, broad, the anterior half bare, the posterior half with an irregular transverse series of thorn bristles with two longer bristles, their apices directed towards one another. Laterally a number of dark thorn bristles. The posterior margin bears dorsally at each hind angle two long bristles and ventrally a single long bristle.

Ventral Aspect (Pl. xlv, fig. 2).—*Basal sternite* with the middle line slightly furrowed, the surface with four irregular rows of short bristles. Ctenidium with 50 to 60 spines. *Sternites* 2 and 3 with the spines along the posterior margin of varying length, only a few reaching to the margin of the next sternite. At the posterior angles are two to three bristles which are semi-erect and curved and may be

longer than those along the margins. Surface bare except for some minute bristles at the sides. *Sternite* 4 nearly as long as the two preceding sternites. Hind margin curved and bearing in the middle short stout thorn bristles arranged in two rows, one on the margin of twelve, the other in front of eleven to twelve shorter bristles. On either side of these extend longer and finer bristles. From the posterior angles some long bristles similar to those of the preceding sternites. In front of the marginal series is a row of semi-erect bristles. *Anal segment* with a number of erect hairs at the sides and at the posterior end. Claspers strong, almost reaching to the margin of sternite 4, slightly separated, their apices directed inwards and downwards. On the outer side of each clasper are some short slender bristles directed outwards, and towards the base are some short and one very long slender bristle directed outwards. These are the pair referred to in the description of the dorsal aspect.

Abdomen ♀ (Dorsal aspect). (Pl. xlv, fig. 3). *Basal tergite* trapezoidal, small and not reaching to the sides of the abdomen, its hind margin widely sinuate and bearing at the hind angles 6-7 large bristles of equal length and one small bristle. At the sides of the disc are short bristles while the middle is bare. *Tergite* 2 is long and broad, and resembles in appearance that of the preceding species. It is subcordate in form and is divided longitudinally into two halves by a faint irregular line. Each side is convexly curved anteriorly and concavely sinuate posteriorly, the hind margins being acuminately produced. Each hind margin bears 3-4 long stout bristles, and in front 4 small thorn bristles. On either side of the dividing line are scattered a few short bristles, a group of bristles is situated at each of the anterior angles, while a few occur along the lateral margins. The tergite is situated well within the lateral margins of the abdomen; anteriorly the basal sternite may be seen extending on either side of the tergite, while posteriorly there is an area of connexival membrane extending at the sides and below the tergite. A series of four moderately long bristles is borne on the lateral margin of the membrane. Below the produced hind margins of the tergite is a chitinised area carrying on its rounded hind margin five suberect bristles. *Anal segment* broader than long, its surface bare. Anteriorly each side is convexly curved while the hind margin is emarginate. From each hind angle springs two long bristles and a group of small thorn bristles.

(Ventral aspect). (Pl. xlv, fig. 4). The abdomen is indented at the sides owing to the collapse of the connexival membrane. *Basal sternite* resembles that of the male, though the segment is broader and longer and the spines are arranged in more irregular rows. *Sternites* 2 and 3 are very short and are entirely covered by the spines of the ctenidium, the ends of the bristles projecting beyond the ends of the ctenidial spines. *Sternite* 4 short, its surface bare, the bristles on the hind margin resembling those of the preceding sternites but spaced farther apart. *Sternite* 5 very much longer, and with two

rows of bristles; one on the hind margin resembling those of the other sternites and with two to three long bristles at the sides, while the second row is situated on the disc at the posterior end. *Subgenital plate* resembles that of the previous species, being broad, membranous, and bare. On the disc towards the posterior end is an irregular row of short bristles. Two moderately long sub-erect bristles are situated between this row and the hind margin. The hind margin is rounded, and has a row of fourteen bristles, those in the middle being arranged in a group of eight while a pair of long bristles on either side of these resemble those at the sides of *sternite* 5. A few short bristles also occur on the sides.

Host.—*Nyctophilus gouldi* Tomes.

Hab.—N.S. Wales, Hazelbrook, Blue Mts., 12.1.1921. 2 ♂ 1 ♀, collected by Mr. L. Abrahams.

Types.—Holotype ♂ K49848, allotype ♀ K49850, and paratype ♂ K49849, in the collection of the Australian Museum.

The principal differences between *falcozi* and *brevicauda* are as follows:—

	falcozi ♀ Large bristles.	*falcozi* ♀ Small bristles.	*brevicauda* ♀ Large bristles.	*brevicauda* ♀ Small bristles.
Basal tergite bearing at either hind angle	4-5	3	6-7	1-3
Tergite 2 bearing on each produced hind angle	2-3	6-7	3-4	4

N. falcozi ♂	*N. brevicauda* ♂
Anal segment (dorsal aspect) *long*, with a number of short bristles scattered over the posterior two-thirds of the segment; others at the sides, arranged along the whole length of the segment.	Anal segment (dorsal aspect) *short*, darkly pigmented, with a group of short dark bristles in the posterior half; others at the sides, arranged along the posterior two-thirds of the segment.

NYCTERIBIA (LISTROPODA) PARILIS *Walker*.

Nycteribia parilis Walker, Journ. Linn. Soc. Lond., Zool., v, 1861, p. 300; Speiser, Arch. Naturg., lxvii, 1, 1901, p. 52.

? *Nycteribia* (*Listropodia*) *stylidiopsis* Speiser, in Voeltzkow, Reise in Ost-Afrika, ii, 1908, p. 200, ♂ ♀.

Listropodia tolisima Speiser MS. Scott, Ann. Mag. Nat. Hist., (8), xiv, 1914, p. 230, as a synonym of *parilis*.

? *Lipoptena tolisina* Muir, Bull. Mus. Zool., Harvard, liv, 1912, pp. 351-366, pl. ii (larva).

Nycteribia (*Listropodia*) *parilis* Scott, Ann. Mag. Nat. Hist., (8) xiv, 1914, p. 231, pl. xii, figs. 20-23 ♂ ♀.

Distribution.—Batchian (Moluccas); Amboyna; Australia; (? Madagascar).

Batchian, 1 ♂ (the type), collected by A. R. Wallace, host unrecorded; preserved dry in British Museum.

Amboyna, a number of males and females from *Miniopterus schreibersi,* 1908, F. Muir.

Australia, 1 ♂ preserved dry in British Museum, labelled "Australia"; presented by Mr. Tomes, 57.7; on "*Miniopterus australis.*"

(Madagascar, see above, remarks on *Nycteribia stylidiopsis* Speiser). This species is not represented in the Australian Museum.

NYCTERIBIA (LISTROPODA) SARASINI *Falcoz.*

Nycteribia (*Listropodia*) *sarasini* Falcoz, Nova Caledonia, Zool., iii, 1923, p. 89, figs. 9-12.

Distribution.—Australia, New Caledonia, Loyalty Islands.

Locs.—New Caledonia; Oubatche (type locality) and Ciu, males and females on *Miniopterus australis* Tomes. Loyalty Is.: Lifou and Képénéé, males and females on the same species. Australia: Mossman, Queensland (F. Muir, Coll. No. 473). This species is also unrepresented in the Australian Museum.

Genus CYCLOPODIA *Kolenati* 1862.

Cyclopodia Kolenati, Horae Soc. Ent. Ross., ii, 1862, p. 82.

Logotype.—*Nycteribia sykesi* Westwood.

Paracyclopodia Scott, Parasitology, ix, No. 4, 1917, p. 608.

Haplotype.—*Nycteribia roylii* West.

Scott has separated the genus *Cyclopodia* into two subgenera, restricting *Cyclopodia* to the type *N. sykesi* Westwood[14], and proposing (p. 608) *Paracyclopodia* for the type *N. roylii* Westwood[15]. The chief differential features appear to lie in the width of the head and elongation of the anterior coxæ. Scott does not refer either to *C. similis*[16] or to *C. pteropus*, which according to his diagnoses fall into *Cyclopodia* s. str.

At the same time he proposed a new genus *Tripselia,* which he regarded as related to *Cyclopodia,* for *Nycteribia* (*Acrocholidia*) *fryeri* Scott, but which does not concern us at present.

[14] Westwood—Trans. Zool. Soc. Lond., i, 1835, p. 288, pl. 36, figs. 1-25.

[15] Westwood—Loc. cit, p. 290, pl. 36, figs. 26-28.

[16] Speiser—Entomol. Nachr. (Karsch) xxvi, 1900, p. 292.

CYCLOPODIA (CYCLOPODIA) PTEROPUS *Rainbow.*

Nycteribia pteropus Rainbow, Rec. Austr. Mus., v, 1904, p. 78, pl. ix.

Cyclopodia pteropus Ferris, Amer. Mus. Novit., No. 110, 1924, p. 5, fig. 5.

Localities.—Mapoon Mission Station, mouth of Batavia River, Gulf of Carpentaria, from *Pteropus gouldi* Gray (Types); Babinda Creek, Queensland, from *Pteropus conspicillatus* Gould. To these previously recorded localities I would add three males and one female collected by me from *Pteropus poliocephalus* Temm. shot in the Botanic Gardens, Sydney, on the 13th April, 1920, and which agree in all particulars with the types of *C. pteropus.* Amongst the wealth of material recently presented to the Australian Museum by Dr. W. E. J. Paradice of H.M.A.S. Geranium, is a fine series of the Spectacled Bat, *Pteropus conspicillatus*, from the North Barnard Islands, south of Cairns, Queensland, from which I was delighted to secure nine males and ten females which are novel to our collection from this bat.

Notes.—In the Australian Museum collection there is a male and female Nycteribid from an unknown host collected by Dr. J. F. Illingworth at Cairns, North Queensland. These are labelled *Cyclopodia similis* Speiser, a species originally described from New Britain in 1901, but I do not know by whom they were identified. They agree in structure with the types of *Cyclopodia pteropus* Rainbow, and if their determination as *C. similis* proves accurate, Ferris's statement, "I am not at all certain that they can be definitely separated," will be shown to be correct, in which event Rainbow's species would become synonymous with *C. similis*, thus considerably extending the range of the species.

Material examined.—The types of *C. pteropus* Rainb., were mounted dry on a card and no single specimen was designated as holotype. Two of these specimens, a male and a female, have been cleared and mounted in Canada balsam, permitting the characters to be seen to greater advantage. The specimens from *Pteropus poliocephalus* are likewise mounted in balsam. In all the female specimens from *Pteropus gouldi* and *P. poliocephalus* examined by me, the long setæ borne at the sides of the abdomen near the apex vary in number from three to four in each group, though in Ferris's figure there are six bristles in each group. In other respects they appear to be identical.

Six specimens from the series secured by Dr. Paradice have been mounted in Canada balsam. In these the females are larger than the females from *Pteropus gouldi* and *Pteropus poliocephalus*, while the males on the contrary are smaller than the males from the other hosts. Otherwise the forms from the various hosts appear to resemble one another closely.

STUDIES ON AUSTRALIAN BRYOZOA.

No. 2[1].

By

ARTHUR A. LIVINGSTONE, Assistant in Zoology, Australian Museum.

(Pl. xlvi and Fig. 1.)

FURTHER STUDIES ON MEMBERS OF THE GENUS CONESCHARELLINA.

CONESCHARELLINA CRASSA (*Tenison-Woods*).

Lunulites (*Cupularia*) *crassa* Tenison-Woods, Trans. Proc. Roy. Soc. S. Austr., iii, 1880 (1879-80), p. 5, pl. 1, figs. 1a-c.

Bipora crassa Whitelegge, Proc. Linn. Soc. N.S. Wales, (2), ii, 1887, p. 343.

Lunulites crassa Jelly, Syn. Cat. Rec. Marine Bryozoa, 1889, p. 140 (synonymy).

Bipora crassa Kirkpatrick, Sci. Proc. Roy. Dublin Soc., vi, pt. x, 1890, pp. 612, 622, pl. xvii, fig. 5.

Conescharellina crassa Livingstone, Rec. Austr. Mus., xiv, 3, 1924, p. 212.

Like its allies, this species has been referred to many genera, and parts of its structure have been misinterpreted by previous authors. The large pores situated far above the peristomial apertures, and which I prove to be filament pores, have been mistaken for vibracular cells by Tenison-Woods; the same pores were obviously mistaken by Whitelegge for the small special pores, characteristic of the genus, and which are usually found situated just above the peristomial apertures. The type specimens of *Lunulites crassa* Ten. Wds. are housed in the Macleay Museum at the University of Sydney, and I have been able to examine them critically in association with a worn specimen from Murray Island, Torres Strait, and a series of fresh specimens from off the coast of New South Wales. The special pore is present in all, but is clearly seen *within* the distal border of the peristomial aperture, a unique position which apparently distinguishes this species from all others of the genus.

[1] For No. 1. See Rec. Austr. Mus., xiv, 3, 1924.

Its unusual situation evidently caused Whitelegge to misinterpret its real nature, and that which he believed to be the special pore characteristic of the genus *Conescharellina* was another into which the base of a long filamentous process was inserted. This last evidently functions as an organ of attachment, and can be seen *in situ* in freshly preserved examples, but is so delicate that it is very easily dislodged when the specimen is handled.

Tenison-Woods' figure of *C. crassa* is a little misleading, as he has shown the zooecia and filament pores (called in his paper "vibracular pores") to be too regular and too close together in relation to their size. The shape of the true zooecial aperture, however, is correct.

Revised description.—Zoarium solid, roundly conical and somewhat depressed; the whole covered by a thin transparent membrane. The zoarium between the peristomial apertures is covered by low calcareous elevations with corresponding depressions and irregularities occurring mostly in the neighbourhood of the apex. These are supplemented by minute pores unevenly distributed over the surface. Zooecia undefined, their apertures and peristomes serving to indicate only approximately their position; the arrangement of the zooecia is in regular linear series.

The zooecial aperture is deeply sunk, pyriform in shape, and with a well defined sinus in its proximal border. The operculum is yellowish and chitinised, fitting perfectly into the aperture and sinus. In general appearance the operculum much resembles that of *C. angulopora*, but it is considerably wider[2].

The peristome is greatly produced at the sides, much as in *C. angulopora*, and on zooecia near the edge of the colony it is prolonged into a tubular structure. Both the normal zooecia and the growing zooecia on the edge of the colony have slit-like peristomial apertures which are much narrower distally than proximally, though the shape of the latter is subject to slight variation.

The special pore is situated above and outside the zooecial aperture, but directly within the narrow distal portion of the peristomial aperture. In some zooecia it is hardly discernible, while in others on the same colony its presence is unmistakable. It extends downwards as a tube from the top of the peristome, through the peristomial aperture, and towards the zooecial aperture. The wall of the tube is yellowish in colour and is of a chitinous nature.

The special filament pores, which may be found later to correspond with the lunoecia found in other species, are situated between the zooecia over the whole upper surface of the colony; they have a circular margin and are almost as big as the peristomial apertures

[2] For figure, see Kirkpatrick (*loc. cit.*).

nearby. These filament pores expand below into cup-shaped cells, which have no connection with the surrounding zooecia except by means of communication pores; these are present on the basal wall of each cell, irregularly spaced, and from two to four in number.

The few filaments still remaining attached to the colony arise from the filament pores, are yellowish in colour, and appear to be incomplete; the longest of these measures about 1 mm.

The avicularia are elliptical or almost rounded; they are irregularly scattered over the surface of the zoarium and sometimes occur conspicuously at the bases of the low calcareous elevations on the zoarium. Each avicularium possesses a distinct crossbar upon which is a well developed central lingula, but this latter structure is sometimes found to be obliterated by wear. The mandibles of the avicularia are semicircular or almost elliptical in shape.

The ooecia are present only on the smallest specimen before me and are very peculiar in shape and structure. They differ from those of *C. philippiensis*[3] in not being smooth all over and globose in shape, though they are external and occupy the same position in relationship to the zooecial aperture as in that species. They are curved and somewhat bean-shaped; their tops are flattened, and at the curved distal end of this flattened area there is a thin, blade-like, calcareous extension bordered by a row of elongated pores. The external surface of the curved distal and lateral ooecial walls is smooth, while the flattened frontal wall is distinctly granulated.

Colour.—Uniform dull yellow as described by Tenison-Woods.

The foregoing description is prepared from several specimens ranging in size from 9.5 mm. by 5 mm., to 3 mm. by 1.5 mm.

Variation.—The smallest juvenile specimen, the only one on which ooecia occur, differs from the adult form in having a greater abundance of avicularia; the produced peristome is present only on zooecia at the extreme edge of the colony, and is not nearly so well developed as in the adult.

The special pore, generally seen within the distal border of the produced peristome of fully developed zooecia on adult colonies, cannot be detected in the young example.

Notwithstanding the variation noted above, I believe the small example to be referable to *C. crassa*, the series at my disposal clearly showing transitionary stages between the small and the large specimens.

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[3] Like Maplestone (Proc. Roy. Soc. Vict., (n.s.) xxiii, pt. i, 1910, p. 6) I cannot see the "fimbriated stigma in front" of the ooecia on specimens in the Australian Museum collection, though on some examples there is a faint, irregular line in front. A belt of pores, however, may be observed at the junction of the ooecia and the frontal zooecial walls, a fact which was not referred to by Maplestone.

Localities.—The Australian Museum collection contains specimens from:—Murray Island, Torres Strait; collected by Messrs. C. Hedley and A. R. McCulloch, 1907: 16 to 18 miles north-east of Port Jackson, New South Wales, 75 to 80 fathoms, trawled by s.s. "Goonambee," May, 1924, and presented by Mr. C. W. Mulvey: about 80 fathoms off the southern coast of New South Wales, trawled by s.s. "Karaaga," August, 1924, and presented by Mr. Melbourne Ward.

The species has been recorded from:—"70-80 fathoms, off Cape Three Points, and Port Stephens," New South Wales, April, 1857 (Tenison-Woods): Murray Island, Torres Strait, 15-20 fathoms (Kirkpatrick).

NOTES ON THE LUNOECIA AND SPECIAL FILAMENT PORES AND THEIR RELATION TO METHODS OF ATTACHMENT.

Whitelegge (*loc. cit.*, 1887, p. 347) gave evidence that filaments served as means of attachment for *Bipora philippiensis*, and that each of these structures *appeared* to grow out of an avicularium, and attach itself to worm tubes and fragments of shell. Maplestone[4], on the other hand, considered that *all* the conical forms had small avicularia and pores on their apices, and filaments similar to those recorded on *C. philippiensis* grew from the pores and probably served to anchor the colony to the sea floor or some submerged object. Unfortunately, this author offered no evidence to support his contention.

Up to the present, anchoring filaments have been discovered on only two species of the genus—*C. philippiensis* and *C. crassa.* They *appear* to arise from avicularia in the former, but in the latter they arise from distinct and specialised pores almost as big as the peristomial apertures of the zooecia. Filament pores similar to those of *C. crassa,* are also present on *C. ampulla* (Maplestone) and *C. eburnea* (Maplestone), but not knowing their function Maplestone called them "large round perforations," though later he vaguely intimated their presence and function in his paper on "Growth and Habits of Biporae[5]". I have searched for traces of anchoring filaments on the type specimens of *C. eburnea* and *C. ampulla* in the Australian Museum Collection without success, but I believe they will be found on fresh specimens and in a similar position to those of *C. crassa.* In this event, the three species would be conveniently associated in a new genus which would provide for forms possessing a conical zoarium, without lunoecia, and with the type of anchoring filament pores indicated above.

[4] Maplestone—Proc. Roy. Soc. Vict., (n.s.) xxiii, pt. i, 1910, p. 3.
[5] Maplestone—*loc. cit.*

We are still ignorant as to the significance of the lunoecia or special crescentic pores which are a characteristic feature of some species of the genus. Whitelegge (loc. cit., 1887, p. 338-9) thought they might be new zooecia forming between the older zooecia, but I share the opinion of Levinsen[6] that such a process is impossible.

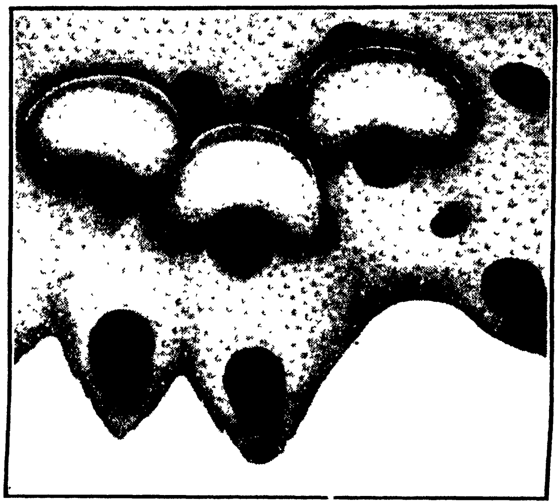


Fig. 1.

The ooecia of *C. crassa* seen near the edge of a juvenile colony. Drawn from a specimen obtained 16-18 miles N.E. of Port Jackson, N. S. Wales, 75-80 fathoms.

Knowing that *C. crassa* possesses anchoring filaments which arise from special cells, is it not logical to suppose that the lunoecia of the related species may serve the same purpose as suggested by Waters[7]? I have examined about sixty preserved specimens of *Conescharellina angulopora* but have failed to find any filaments. This may be due to imperfect preservation, however, and I think they will be discovered in fresh specimens.

[6] Levinsen—Morph. Sys. Stud. Cheil. Bryozoa, 1909, p. 310.
[7] Waters—Journ. Linn. Soc. Zool., xxxiv, 1918-22, p. 406.

AUSTRALIAN PLATYPEZIDAE [DIPTERA].

By

A. L. TONNOIR, Assistant, Canterbury Museum, Christchurch, N.Z.

(Figures 1 and 2.)

To my knowledge no species of Australian Platypezidae have been described with the exception of one which was erroneously placed by A. White in the Empidae[1].

When collecting in Australia and in Tasmania in the years 1921 and 1923, I came across a few specimens of that family belonging to two species, and later Dr. Eustace W. Ferguson was kind enough to send me for study some specimens which he had collected in New South Wales. My best thanks are due to him for the loan of this material, which I have returned to him; the types are deposited in the Australian Museum, Sydney.

All these specimens belong to the genus *Platypeza,* and are small and inconspicuous forms of moderate interest, among which I distinguish four species that are rather difficult to differentiate unless a careful investigation of the male genitalia be made.

The species described by White, *Ironomyia maculata,* is, on the contrary, very interesting on account of its peculiar characters, which give it a special place in the family.

The chief characters of the Platypezidae may be summed up as follows:—

Head large; eyes nearly always touching in the male for a long space, well distant in the female; upper facets of the male's eyes nearly always dilated; antennae composed of three simple joints, the third joint being always larger than the others and sometimes conspicuously so, and provided with a terminal arista which has usually a small basal segment. Thorax with chaetotaxy little developed, only on the sides of the mesonotum and the edge of the scutellum. Legs nearly always with the hind tibiae dilated and also the first three or four joints of the hind tarsi; the genera *Opetia* and *Ironomyia* form an exception in this peculiar character of the family. The wings have a peculiar glassy texture, their venation varying a great deal according to genera; in the majority the anterior branch of M is forked and the discal cell is present, besides the vein Cu_1 meets the anal vein in an acute angle, the so-called anal cell being therefore somewhat elongated; the genera *Opetia* and *Ironomyia* again form an exception in that respect.

1 White—Proc. Royal Soc. Tasmania, 1916, p. 217.

The two Australian genera may be easily distinguished in the following manner:—

1. Eyes touching in the male; hind tibiae and base of hind tarsi dilated. Sc not fused with R_1, $M_1 + {}_2$ forking near the tip of the wing a long way from the posterior cross vein; anal cell with its extremity acute. *Platypeza.*

2. Eyes only approximated in the male; hind tibiae and tarsi not dilated; Sc fused on a great part of its length with R_1; fork of M long, placed at the top of the posterior cross vein which is oblique; anal cell with its extremity rounded. *Ironomyia.*

Genus PLATYPEZA *Meig.*

Key to the Species.—

(Until more material is obtained, the species can be safely differentiated only in the male sex, and on characters given by the genitalia.)

1. Distal end of the claspers rounded 2
   Distal end with a sharp tooth .... *P. acuminata*, n. sp.
2. The subanal internal lamellæ with a long pointed projection at their internal corner .... *P. fergusoni*, n. sp.
   The subanal lamellæ without projection 3
3. Subanal lamellæ with their edge denticulated .... *P. denticulata*, n. sp.
   These lamellæ with a smooth edge .... *P. griseola*, n. sp.

As the four species are very similar, I shall describe only one of them at some length and compare the others with it.

PLATYPEZA FERGUSONI *n. sp.*

(Figure 1A.)

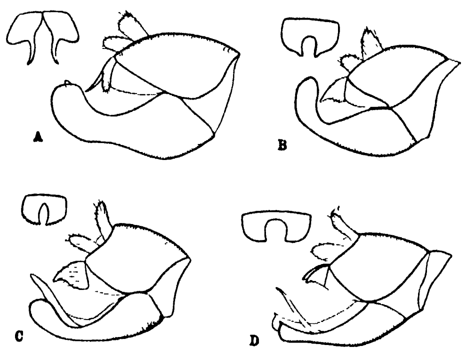


Figure 1.
A. Hypopygium of *Platypeza fergusoni* in profile. B. *P. griseola.* C. *P. denticulata.* D. *P. acuminata.* On the left of each hypopygium is represented the sub-anal lamellae of the corresponding species.

MALE.

Specific Characters.—Velvety black, the abdomen with grey markings at the tip and on the side of the base of the penultimate visible segment; halteres brown; legs brown with lighter parts at the knees and on the tarsi.

Face and frons bare; antennae dark with the third joint roundish, only a little larger than the preceding one; arista bare, about three times as long as the three first joints.

Thorax with the usual chaetotaxy; scutellum with four erect bristles; abdomen with a rather long black pubescence.

First and second joints of the hind tarsi equally broad, the first distinctly longer; third joint narrower, about as long as the first; fourth joint nearly normal; distal border of the two first joints convex on the external face of the tarsi, straight on the internal face.

Venation.—Sc ending a little before the middle of the wing; *r-m* placed much before the end of that vein; M_1 about three times as long as M_2; *m* very little longer than the last part of M_3, first part of A distinctly but not much shorter than the last one; stigma not distinctly coloured.

Hypopygium as per Fig. 1A; the side-pieces relatively short and broad with a well rounded extremity; the sub-anal internal lamellae with a long projection at their internal corner, this projection slightly curved outwards.

Length of body $2\frac{2}{3}$ mm., wing 3 mm.

FEMALE.

Venation as in male, differing only sometimes in M_2 being not quite so short; face and frons bare, the latter about one-quarter of the total head width; antennæ as in male.

Mesonotum grey with four little distinct darker bands; abdomen velvety black with grey markings, the first segment completely grey (when seen from the side), the second to the fifth with a basal transverse grey band interrupted in the middle, sixth completely grey. Halteres ochraceous. Legs lighter than in the male especially the tarsi; hind tarsi much broader than in the male, the second and third joints relatively smaller than the first, the third being of the same width as the preceding one.

Same size as in the male.

Holotype, male, Hobart, January 4th, 1923 (A. Tonnoir). This specimen was collected in sweeping the grass around the water reserve pond.

Paratypes, four males and five females bred from agaric by Dr. Ferguson, Sydney, April, 1917. One female from Wilmot, Tasmania, January 8th, 1923 (A. Tonnoir).

Another female found by the writer on Mount Wellington, Tasmania, differs from the others by some detail of colouration, and may belong to another species, but, as it is rather insecure to base a new species on a single female specimen, I will only note here the difference to call attention to this form. The palpi are bright orange, the proboscis a little darker. There are six bristles on the scutellum and the prescutellar bristles are more numerous. The fifth abdominal segment is completely grey, the base of the femora orange, the knees more broadly so, and also the tarsi.

Platypeza griseola *n. sp.*

(Figure 1B.)

Male.

Specific Characters.—Very similar to the preceding species, from which it differs only by some details of colouration, by a few minor points in the venation and by the structure of the hypopygium.

The two first joints of the antennae orange (the third missing); palpi orange, labellum darker. Mesonotum greyish black with very indistinct bands. Halteres brown, their stem and apex of the knob lighter. Abdomen black with extensive greyish markings; sides of first and second segments grey, third and fourth with a grey transverse band extending nearly their whole width but not touching their anterior border and interrupted in the middle, fifth and sixth segments completely grey but for a narrow transverse black line at their base. Legs brown ochraceous, knees and tarsi lighter.

Venation.—*r-m* nearer the level of the extremity of Sc; M_2 relatively longer and the last portion of M_3 equal to *m* or slightly longer.

Hypopygium with the side pieces not so broadly rounded at the tip, internal lamellae without internal projection (see Fig. 1B).

Size: Body and wing 2½ mm.

Holotype male, Sydney; bred from agaric with the preceding species by Dr. Ferguson.

Platypeza denticulata *n. sp.*

(Figure 1C.)

Male.—Nearly completely dull species with only the anterior tarsi somewhat lighter and the apex of the sixth abdominal segment grey.

Venation as in *P. fergusoni*, differing only by the stigma being more distinctly marked, by shorter M_2 (being about ¾ of M_1), by *m* being equal to the last part of M_3. Hind tarsi similar.

Hypopygium according to Fig. 1C; clasper of about the same shape as in the two preceding species but more elongated; sub-anal lamellae gently denticulated on their edge.

Size of body and wing respectively: $2\frac{2}{3}$ and $2\frac{1}{2}$ mm.

Holotype: Sydney, August 26th, 1923 (Dr. Ferguson).

A female specimen from Sydney, May 21st, 1923, is very doubtfully referred to the above species. The venation agrees rather well, but the hind tarsi are much wider and the colouration differs, as is usually the case for the females in this family.

Face grey, frons black, mesonotum black, with only a slight greyish tinge without any band. Abdomen velvety black, the segments 2, 3, and 4 with a basal transverse band interrupted in the middle, segment 5 completely black and 6 completely grey. Wing $2\frac{1}{4}$ mm.; body 2 mm.

PLATYPEZA ACUMINATA, *n. sp.*

(Figure 1D.)

Male.—Similar to *P. fergusoni*, but abdomen black, slightly shining, only the 6th segment dull grey. Venation also similar, only M_2 relatively shorter.

Hypopygium (Fig. 1D); quite distinct by the extremity of the claspers which carries a tooth; penis with a sharply pointed extremity, whereas it is blunt in all the other species.

Holotype: Sydney, October 10th, 1921 (Dr. Ferguson).

Genus IRONOMYIA *White.*

As already mentioned, the genotype *I. maculata* White was placed by that author in the family Empidae, but I think there can be no doubt that this species belongs to the Platypezidae. Confusion between these two families has occurred more than once; for instance Meigen placed *Cirtoma* and *Micropterus* in the Platypezidae, and the genus *Microsania*, which has been always considered as belonging to the Empidae, has been recently recognised as a Platypezid by Melander.

Professor Bezzi, to whom I sent some specimens of *Ironomyia*, also considers them to belong to the Platypezidae.

In his generic diagnosis White says that the eyes are touching in the male and that the proboscis is short, hardly projecting from the oral aperture. This is not the case, as shown by Figures 2B and C; the eyes of the male are closely approximated but not touching, and the proboscis and palpi are of fair length.

His account of the venation is nearly correct, with the exception that Sc is not completely fused with R_1, its base and tip being free. As his figure is rather inaccurate, I am giving here a camera lucida drawing of it (see Fig. 2A), which also shows better the peculiar shape of the Platypezid wing. From the median vein backward the venation is strikingly similar to that of some Empidae, and consequently well distinct from that of any known Platypezidae. The fork M_1 M_2 is brought back to the middle of the wing, right against the posterior cross vein, which is almost longitudinal in direction, giving thus to the discal cell a shape which is never found in the Platypezidae but often in the Empidae. The vein Cu instead of joining A under an acute angle is bent into a short curve and meets A at right angle; this is therefore similar to what is found in the Hybotinae; it must be this peculiar feature that induced White to place this insect in that sub-family of the Empidae, to which its general facies bears however no resemblance whatever.

The structure of the antennae is rather divergent from what is found in the Platypezidae, it is more like the antennae of some Muscoidea. The peculiar manner in which the third segment is articulated with the second is worthy of notice (see Figures 2B and C); it is to some extent similar to what is found in some Dolichopodidae.

The hind legs do not show the peculiar character of the Platypezidae, their tibiae are gradually widening towards the extremity, which is not flattened, the metatarsi are somewhat thicker than the other joints, but the tarsi are in no way dilated as is the case of all Platypezidae with the exception of *Opetia*. Besides the tibiae of all the legs carry some bristles dorsally, two on the anterior ones and three or four on the hind ones.

In spite of all these diverging characters *Ironomyia* must be considered as a Platypezid chiefly on account of the nature of its teguments, the texture of the wing, its venation, especially in the anterior part of the wing, and the nature of the stigma, as well as the shape of the head.

IRONOMYIA MACULATA *White.*

(Figure 2.)

Only the male of this species was known to White. I found in Tasmania three specimens, one female on Mount Wellington in November, 1922, and a male and a female together in the Cradle Valley in January, 1923.

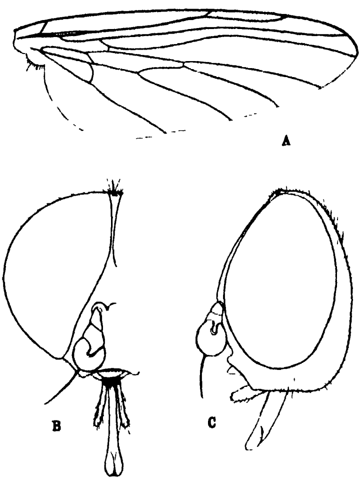


Figure 2.

Ironomyia maculata.—A. wing; B. head seen from the front; C. head in profile.

The female differs from the male as follows:—

Face and frons grey, peristoma shining black on the sides; the width of the frons is equal to $\frac{1}{5}$ of the whole head. Antennae grey, edge of the second joint ferruginous. Mesonotum brownish grey with four longitudinal bands, the external ones placed after the suture and much on the side; between the internal ones there is a very narrow dark line on the posterior part of the notum. Scutellum dark, its sides grey. Halteres with light stem and dark knob.

Abdomen brownish grey with three series of black velvety spots, a median one and two lateral, the posterior edge of the segments being silvery grey in front of the lateral black spots: the first segment is completely grey. Legs as in the male.

Size: Body 6mm., wing 6 mm.

A REVISION OF THE GENERA TAPHOZOUS AND SACCOLAIMUS (CHIROPTERA) IN AUSTRALIA AND NEW GUINEA, INCLUDING A NEW SPECIES, AND A NOTE ON TWO MALAYAN FORMS.

By

ELLIS LE G. TROUGHTON, Zoologist, Australian Museum.

(Plates xlvii-xlviii.)

When recently compiling a popular work upon the bats of Australia and New Guinea, I found it impossible either to differentiate or discredit certain species hitherto included in the genus *Taphozous*.

The type of Ramsay's *hargravei* was known to be in the Australian Museum collection, and a review of all the material yielded other interesting specimens, most important of these being the type of *T. flaviventris* Peters. This type has not been examined or commented upon since Gould returned it to Waterhouse, after its description in 1866, when the author failed to remark upon the absence of wing pouches; this omission, coupled with his likening the species to *australis*, led to a Taphozoan tangle which this paper endeavours to unravel. Also in the Museum collection are two specimens from Port Moresby, Papua, whose characters and colouration apparently warrant their description as a new species.

Upon appealing to the Director of the Queensland Museum, Mr. H. A. Longman, F.L.S., as to the validity of De Vis' species, *nudicluniatus* and *fumosus*, he promptly forwarded me typical material of the two species for examination, and has since very kindly forwarded four *flaviventris* from Queensland. In the same liberal manner the Committee of the Macleay Museum has kindly placed the bats of that collection at my disposal.

I am, therefore, very favourably equipped with material for the purposes of this paper, which endeavours to reorganise the New Guinea and Australian species previously relegated to *Taphozous* in its unrestricted form; the seven species hitherto recorded for the above area are reduced to three, their characters being reviewed and more clearly defined. The addition of one new species, and the elevation of *T. a. georgianus* to specific rank, makes five species in all for the area under review.

To the authorities of both the above institutions my most sincere thanks are due for their generous response to an appeal for material; also to Mr. John Shewan, Curator of the Macleay Museum, for his help in selecting specimens. I also desire to express very sincere thanks to my friends, Messrs. Allan R. McCulloch and Tom Iredale, for their helpful comment and advice, and to Miss Joyce K. Allan and Mr. J. R. Kinghorn, for their help in preparing several illustrations.

The genera TAPHOZOUS and SACCOLAIMUS.

Dobson (1875) divided *Taphozous* into two subgenera, *Taphozous* and *Taphonycteris,* and Hollister (1913) later regarded the two as distinct genera. Thomas (1915) also admitted their generic status, but pointed out that the name *Saccolaimus* antedated that of *Taphonycteris* by many years. He also (1922) synoptically arranged the genera of the *Taphozous* group. An examination of all the material available to me, however, shows that an important character used to separate *Taphozous* and *Saccolaimus* is not constant.

Though the absence of wing pouches has been considered typical of *Saccolaimus,* De Vis wrote that they were either very small or absent in his *nudicluniatus,* which has the complete bullae typical of *Saccolaimus.* Further, upon examination of a new species described below, I find the complete bullae typical of *Saccolaimus,* and the clearly developed wing pouches of *Taphozous.* In view of these conflicting characters it is necessary to modify Thomas' synopsis, and, as I consider the character of the bullae alone insufficient to distinguish the genera, it appears to me probable that additional material may prove the generic distinction untenable. Meanwhile the two genera may be synoptically arranged thus:—

A. Bullae perfect, the antero-internal sides complete. Upper anterior premolar proportionately larger, and acutely cusped. Radio-metacarpal pouch rudimentary or absent (well developed in *mixtus* only). Inner margin of ear not papillate. Lower outline of mandible convex beneath premolars in the Australian and New Guinea species ...... *Saccolaimus.*

B. Bullae imperfect, the antero-internal sides incomplete. Upper anterior premolar proportionately very small and simple, not acutely cusped. Radio-metacarpal pouch always well developed. Inner margin of ear papillate. Lower outline of mandible markedly concave beneath premolars in the Australian and New Guinea forms .... *Taphozous.*

Genus SACCOLAIMUS *Temminck.*

Saccolaimus (Kuhl MS.) Temminck, Monogr. Mamm., ii, 1841, pp. 277, 279 (Type by tautonomy *T. saccolaimus* Temm., *Ibid.,* p. 285). *Id.,* Lesson, Nouv. Tabl. Regn. Anim., 1842, Mamm., p. 19 (published as a synonym of *Taphozous* from Kuhl MS.). *Id.,* Miller, U.S. Nat. Mus. Bull. 57, 1907, p. 93. *Id.,* Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1915, p. 57, and Ann Mag. Nat. Hist. (9) ix, 1922, p. 266.

Taphonycteris Dobson, Proc. Zool. Soc. 1875, p. 548, and Cat. Chir. B.M., 1878, p. 379 (subgenus for *T. saccolaimus, affinis,* and *peli*). *Id.,* Monticelli, Ann. Mag. Nat. Hist. (6) iii, 1889, pp. 487-9. *Id.,* Hollister, Proc. U.S. Nat. Mus., xlvi, 1913, p. 308. *Id.,* Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1915, p. 57.

Diagnosis.—Bullae complete antero-internally, there being a total lack of the emargination of their inner sides such as found in *Taphozous*. Radio-metacarpal pouch absent except in *nudicluniatus* (very small or absent), and in *mixtus* (clearly developed). Lower lip divided in front by a deep groove which varies in depth, but is always more clearly marked than in *Taphozous*. Inner margin of ear not papillate. Small anterior upper premolar proportionately much larger, and with a longer and more acutely pointed cusp than is found in the allied genus. Lower outline of the mandible convex beneath the premolars, in the three Australian and New Guinea species.

Genotype.—*S. saccolaimus* (*T. saccolaimus* Temminck).

Range.—India, Ceylon, Burma, Philippines, Austro-Malaysia, New Guinea to Australia.

Synonymy and history.—*Saccolaimus* was omitted by Dobson but is quoted by Miller as of Lesson in such a manner that the name could have been regarded as a pure synonym of *Taphozous*, as Lesson's work is unavailable to me. The name was revived by Thomas (1915) without any information concerning its history, and its validity was therefore in doubt according to the records given by the two authors. I have, however, traced the original introduction by Temminck as above, definitely establishing the validity of *Saccolaimus*.

Key to the species occurring in Australia and New Guinea:—

A. Undersurface conspicuously lighter than upper. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits deep, their median ridge high, rising to the level of the floor of the mesopterygoid fossa.

a. Forearm 70 - 80 mm. Wing pouches absent. Small secondary gular sac present. Undersurface creamy white. Basal length of skull 22 - 23.5 mm. .... *flaviventris*.

b. Forearm 61.5 - 62.5 mm. Wing pouches present. Secondary gular sac absent. Undersurface pale buff-brown. Basal length of skull 18.5 - 19 mm. .... *mixtus*

B. Undersurface not conspicuously lighter than upper. Posterior floor of mesopterygoid fossa smooth, without a deep groove. Sphenoid pits shallow, their median ridge low, not rising nearly as high as the floor of the mesopterygoid fossa .... *nudicluniatus*.

SACCOLAIMUS FLAVIVENTRIS *Peters*.

(Pl. xlvii-xlviii.)

Taphozous flaviventris Peters, Proc. Zool. Soc. 1866 (1867), p. 430. *Id.*, Waterhouse in Harcus, South Austr., 1876, p. 192 (record only). *Id.*, Dobson, Cat. Chir. B.M., 1878, p. 382. *Id.*, Ogilby, Cat. Mamm. Austr., 1892, p. 96. Id., De Vis, Ann. Q'land Mus. No. 6, 1905, p. 37, and 38 (footnote). *Id.*, Lönnberg, Kungl. Svensk. Vet. Ak. Handl., lii, 2, 1916, p. 3 (record only).

Taphozous australis, var. *flaviventris* Dobson, Proc. Zool. Soc. 1875, p. 551.

Taphozous hargravei Ramsay, Proc. Linn. Soc. N.S. Wales, i, 1, 1876, p. 81. *Id.*, Dobson, Cat. Chir. B.M., 1878, pp. 382-3. *Id.*, Ogilby, *loc. cit.* *Id.*, De Vis, *loc. cit.*

Taphozous affinis, var. *insignis* Leche, Proc. Zool. Soc., 1884, pp. 51-53, fig. 4 a-e. *Id.*, Ogilby, *loc. cit.*, pp. 96-97.

Diagnosis.—Forearm 70-80 mm. Size large, females slighter in form and skull dimensions. Male with a large gular sac, (Pl. xlvii, fig. 1) upon the ventral wall of which is situated a small secondary sac; gular sac absent in females. Wing pouches absent in both sexes. Outer base of ear commencing exactly midway between the corner of the mouth and the rear base of the tragus. Lower lip grooved in front. Colour above auburn to blackish brown; creamy white below. Basal length of skull 22-23.5 mm. *Hab.* Australia.

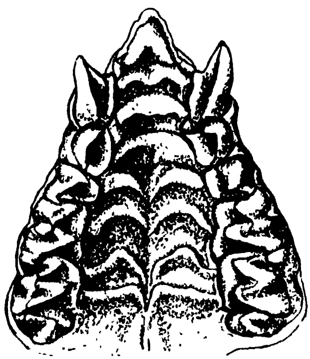


Fig. 1. Palatal ridges of *S. flaviventris*.

External characters.—Inner margin of ear commencing above the eye, slightly convex to the tip; the outer margin is slightly concave below the tip, followed by an even convexity, ending opposite the tragus where the margin is thickened and emarginate, thence convex to the outer base situated midway between the angle of the mouth and the tragus base. Outside of ear almost naked except for a sparse edging of hairs at the base; inside sparsely but evenly haired. Tragus (Pl. xlvii, fig. 1e) with inner edge evenly concave, rounded but somewhat uneven above, a deep notch just below the top on the outer edge. The groove in the centre of the lower lip is not so sharply incised, nor the ridges on each side so clearly defined as in Dobson's figure of *affinis* or my specimen of *saccolaimus*, the borders of the groove being broadly and smoothly rounded. The width between the nostrils is also greater than in the figure of *affinis*, in which they are shown as barely separated. Palatal ridges (Fig. 1) with the four hindmost divided into double arches. Measurements on p. 321.

Pelage.—Head well furred to between the eyes, thence the snout is sparsely covered with short hairs to its tip. Fur of back extending a short distance onto the wing membrane, to a line drawn between the upper thirds of the humerus and femur; the long fur barely extends onto the interfemoral, ending in a straight line slightly beyond the tail-root, rest of membrane very slightly haired. Below the wing membranes are lightly furred as above.

Skull (Pl. xlviii, fig. 1a-d).—Palation slightly posterior to the lateral palatal edges. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits smaller but deeper than in *nudicluniatus,* and, unlike the condition in that species, the median dividing ridge rises as high as the floor of the mesopterygoid fossa. Saggital crest well defined and extending to the occiput. Lower outline of the mandible roundly convex beneath the canine and anterior premolar, thence almost straight posteriorly, there being no trace of the marked concavity found in *T. australis.*

A careful comparison of the crania of the types of *hargravei* and *flaviventris,* and the male from Moree with the secondary pouch, as well as crania from Queensland localities, shows them to agree in all characters and in general contour. The skull of the type of *hargravei,* in my opinion an adult female, is slightly more slender in general proportions, the frontal region is not so broad or the forehead so deeply excavated, and the brain-case is not quite so inflated as in males. There is a skull of a female from Eidsvold, Queensland, exactly the same length as the *hargravei* skull, with which it agrees in all details, the conclusion therefore being that the slightly shorter length and more slender build is typical of the skulls of females of *flaviventris* over a wide range. Correspondingly three males, including the type of *flaviventris,* the Moree specimen, and one from Queensland, have skulls of the same length, and very consistent in having the same dimensions and general contour.

Small upper anterior premolar proportionately very large, equal to half, or more than half, the size of the posterior premolar; the cusp long and sharply pointed.

Variation.—A series of twelve specimens indicates that the colour of the back is decidedly variable, ranging from a darkish auburn brown to blackish brown with black tips. Hitherto *flaviventris* has been regarded as a yellow-bellied form as opposed to the white-bellied *affinis,* but it appears that the under surface of specimens of *flaviventris* is somewhat variable in colour. This conclusion is supported by statements contained in letters from Miss Florence M. Irby, of Casino, New South Wales, who presented two specimens to the Museum, and who wrote of the under surface colour:—"My brothers found five in a hollow tree . . . two are creamy white, others yellowish and one a pure white. I have now examined nine of these bats and can see absolutely no difference in them beyond that of the colours underneath. I really think it is merely a difference of age. The first four examined were pure white." The fur is unicoloured, though somewhat lighter basally above and below.

The large gular sac and small secondary sac on its ventral wall are present in the spiritous males from Moree, New South Wales, and Eidsvold, Queensland, and, in my opinion, the secondary sac is faintly discernible in Peters' mutilated type. In the nine dried and spiritous females examined there is no trace of the development of rudimentary edges of a gular sac, though in several specimens there is a slight difference in the integument, or sparseness of the fur, which indicates the area of the gular sac.

Leche described and figured the tragi of the type of his var. *insignis* as being differently shaped on each side, but each tragus in all my specimens of *flaviventris* is similar in shape to the right hand tragus of *insignis* (fig. 4 b.), the left tragus of Leche's type apparently being distorted.

History and characters of type.—Waterhouse forwarded the type specimen, a male, to Gould, and the species was described by Peters in 1867, who stated that it was "represented by a single male submitted to my examination by Mr. Gould." The type was returned to Waterhouse, who forwarded it to the Australian Museum as part of an exchange in 1871, the specimen being listed in a letter headed "South Australian Institute, Museum, Adelaide, 5 July, 1871," with the following note in Waterhouse's handwriting: "separate 1. *Taphozous flaviventris.* Bad but *only* duplicate at present. This specimen was sent to Gould and is described in Proc. Z. Soc., Nov., 1866." From the foregoing it appears that Waterhouse sent the type, which was in very bad condition and whose value was not then so apparent, preferring to keep the better but far less interesting duplicate.

In describing the type of *flaviventris,* which is a male, Peters traced the existence of the "large fossa" or gular sac common to many species of the genus but, owing to the mutilated condition of the type, failed to observe any traces of the small secondary sac, whose presence he probably did not even suspect. However, in spite of the rough incision through the centre of the gular region, it is still possible to discern the edges of the large gular sac. I also consider that with care, under strong binoculars, one can trace the edges of a small secondary sac such as is figured for *insignis.* The mutilation of the specimen doubtless took place with the original skinning, Waterhouse having referred to the "bad" condition of the specimen in 1871, and it was doubtless in this damaged and poorly preserved state when examined by Peters. Though unable to discern any very certain signs of the secondary pouch in the type, I infer that Peters' specimen possessed this feature in common with Leche's type of the variety *insignis,* as the Moree and Queensland males, which both possess the secondary pouch, agree with the type of *flaviventris* in every other plastic and cranial character.

After careful examination I can definitely state that there are no traces of wing pouches in Peters' type, and therefore *flaviventris* is distinguished from *australis* by the total absence of the wing

pouches which are so well developed in the latter, and not only by size and colour as hitherto understood. Unfortunately Peters overlooked mentioning that *flaviventris* lacked wing pouches, therefore his statement that it was "nearly related" to *australis*, being "different in colour and its superior size" misled subsequent authors, who believed that *flaviventris* also possessed wing pouches. Much confusion has resulted from this belief, and Dobson, being unable to examine Peters' type, stored in the Australian Museum since 1871, placed the species next *australis* in the wing-pouched section of the genus. Consequently De Vis, supposing that *flaviventris* possessed wing pouches, erroneously maintained that "*hargravei* is a sound species and a fine one," because the latter lacked them.

Discussion of Synonyms.

T. hargravei.—A detailed examination of Ramsay's type satisfies me that Dobson was correct in regarding *hargravei* as synonymous with *flaviventris*, though in spite of Ramsay's definite statement that "There is no sign of a gular pouch," Dobson cast doubt upon its absence which he regarded as "the only difference of importance." Indeed, were the type of *hargravei* a male, the absence of the pouch would have served to separate the two species, all the males of *flaviventris*, possessing well developed pouches. However, I cannot agree with Dobson's suggestion that Ramsay might have failed to observe the presence of a gular pouch, after having "examined it carefully in water." Examination of the type of *hargravei*, whose measurements, colour and plastic characters agree in detail with a female *flaviventris* from Moree, convinces me that no gular pouch existed in Ramsay's type. A feasible explanation is that owing to the remarkable prolongation of the female genitalia anteriorly, Ramsay mistook the sex of his type, which is really a female and not a male as stated by him. As in several other species of the *Taphozous* group, there is no trace of even the rudimentary edges of a gular pouch in females of *flaviventris;* the absence of the gular pouch in Ramsay's type therefore confirms the identity of the two species.

T. affinis insignis.—In describing his South Australian specimen as a variety of the Malayan *affinis*, Leche was apparently unaware of the existence of *flaviventris* as he wrote that "up to this time only one Australian species belonging to this genus is known, viz., *T. australis*, Gould."

There is a male in the Australian Museum collection from Moree, N.S.W., which has the large gular sac with a small secondary sac on its ventral wall, as described and figured by Leche for *affinis insignis.* A detailed comparison of this specimen with Peters' type of *flaviventris* shows them to agree exactly in their colour and cranial characters, their measurements and plastic characters also being quite in accord, excepting only the uncertainty regarding the presence of the secondary pouch in Peters' type.

Summary.—Just as the Moree male agrees in detail with Peters' type and Leche's description, so a female in the collection, which is also from Moree, agrees in every external detail, including colour and dimensions, with Ramsay's type of *hargravei* from Bulli, New South Wales. The association of the male and female forms in the same district at Moree further confirms the conclusion, of which I have no doubt, that *affinis insignis* represents the male, and *hargravei* the female of *flaviventris*. Contributing factors in the general confusion were that Peters was unable to discern traces of a secondary pouch and also failed to note the absence of wing pouches in his type; another factor being that both Leche and Ramsay overlooked the existence of *flaviventris* in describing their types, the latter author apparently being unaware that Peters' type was actually in the Museum collection.

Type.—An adult male, in the "old collection" of the Australian Museum. Received in exchange from F. G. Waterhouse in 1871, and entered as No. 137 in the Museum's earliest register compiled by Secretary Palmer about the year 1877. Tied to the type is an old label reading "*Taphozous flaviventris*, Gould, Proc. Zool. Soc., 1866, Male—Type." In view of this label and Waterhouse's letter noted above, I have no doubt that this specimen is the type of the species.

Other specimens examined.—A series of eleven males and females including the type of *hargravei* registered No. M.2349 in the collection of the Australian Museum, also four specimens lent by the Queensland, and one by the Macleay Museum.

Localities.—Bulli, Moree, and Casino, N.S. Wales; Woody Point, Eidsvold, Moreton Island, Charters Towers, and Cairns, Queensland; Port Darwin, Northern Territory.

Distribution.—South Australia (Leche), and northern South Australia (Waterhouse): Northern Territory; Queensland; New South Wales.

Conclusion and comparison with ally.—Upon reviewing a large series of specimens, including the type and that of a synonym, from a wide range of localities, I have no hesitation in concluding that *T. hargravei* and *T. affinis* var. *insignis* are synonymous with *flaviventris*.

Apparently most nearly allied to the *affinis-saccolaimus* form of India and Malaysia, *flaviventris* is readily distinguished by having a small secondary pouch situated on the ventral wall of the large gular sac in males, and by the females lacking even the rudiments of a gular sac such as is found in females of the allied form. The possession of the secondary pouch in males is apparently unique amongst Australasian members of the *Taphozous* group, being absent in the new species described herein, and doubtless lacking in *nudicluniatus* too, though males of the latter are not yet known. The simple flattened form of the tragus also serves to distinguish *flaviventris* from the two local allies.

Measurements of eleven examples of *Taphozous flaviventris* from **Australia.**

	137 Peters' type. Male. South Australia	M 2349. *hargravei* type. Bulli, N.S W.	M. 918. Male. Moree, N.S.W.	M 3228 Female. Moree, N.S W.	*affinis insignis.* Leche. South Australia	J. 1945. Male. Woody Pt., Queensland	J. 3082-3. Eidsvold, Queensland Male.	J. 3082-3. Eidsvold, Queensland Female.	J. 4069. Female. Moreton Island, Queensland	M. 1667 Female. West of Charters Towers, Queensland	Macleay Museum. Female. Port Darwin
Forearm	76	77	80	76	70	76.5	79	75	74	70	73
Pollex—total length, c.u.	12	11.5	11.5	11.5	....	11	12	11.5	11.5	11	10
2nd Digit—metacarpal ...	74	73.5	79.5	75.5	....	73.5	76	70	73	73.5	70
3rd Digit—											
Metacarpal . ..	80	80.5	84	80	68	79	82	76.5	77.5	70	76
1st phalanx . ..	33.5	34.5	34.5	34.5	. .	34	38.5	33	34	30.5	32.5
2nd phalanx	35	38	39	39	. ..	36	39	37	36	32.5	35
4th Digit—											
Metacarpal ..	63	63	67.5	64.5	......	60	64.5	61	60	53	59
1st phalanx . ..	20	20	20	18.5	. .	19.5	21	19	20	17	19
2nd phalanx	7	7.5	7.5	8	. .	7	8	7.2	8.5	6.5	6.5
5th Digit—											
Metacarpal ...	48.5	50 5	52	51	41	49.5	52.5	47	48.5	44	46
1st phalanx .	16·5	17	18.5	16.5	. .	16	18.5	17	18.5	16.5	16
2nd phalanx	10	9.5-11	11.5	11.8	.	11	11.5	11	11.5	10	10.2
Tragus—											
Length from middle of base.	5	5	5.5	5	7 (*vide* Leche)	5.5	5.2	5	5	4.6–5	5.8
Width of top .. .	5	4	4.7	4.8	... ..	5	5	4.8	4.5 & 5	......	5.5
Ear—											
Length from outer base	22	20	23.5	21	25	24	23	21	23	20	23.5
Max. breadth flattened	14.5	13	15	15	.. ..	15	14	14	14.5	14.5	15
Tail—											
Free portion	9	5 –,–	7.5	10	9	12	15	10.5	11	7.5	10
Total length ..	25 –+–	23	28	24.5 – –	23	27	31.5	28.5	31.5	17.5 – –	27
Tibia	28	28	28.5	28	26	27.5	30.5	27.5	27	25	27.5
Foot—c.u.	15	14·5	14.5	14.5	.. ...	14	15	14.5	15.5	14	13.5
Corner of mouth to external base of ear	6	......	6	6	....	6	5	6	.. ...	6	5

Regarding these dimensions it should be noted that the measurements of a dried skin agree perfectly, to within a mm., with the spiritous type, excepting only in those features obviously subject to distortion in skinning, and in the 2nd phalanges of the 4th and 5th digits, which vary considerably in the same specimen. A duplicate skull also agrees perfectly in contour and measurements (within 0.5 mm.) with those given above. For additional measurements see pages 340-341.

Hab.—Port Moresby, Papua.

Type.—Adult male, number A.3257 in the Australian Museum collection. Other specimens, a dried skin and skull, A.3258, and an odd skull, A.3256, all from Port Moresby, and purchased from Kendal Broadbent in November, 1878.

Note on the typical series.—It is worthy of comment that Ramsay appreciated the differences exhibited by the specimens which are registered in the Australian Museum collection as "M.3256-8, *Taphozous australis,* Port Moresby, Purchased Kendal Broadbent, Nov., 1878." Under the reference quoted above Ramsay wrote: "Specimens from Broadbent's collection. Under surface ashy white, back brown, wings and face black, otherwise the same as the Cape York examples, from which it may prove to be specifically different."

Comparison with allies.—A small form distinguished from *flaviventris* and *saccolaimus* by the possession of wing pouches, and its much shorter forearm and skull. It may be further distinguished from the former by the shallow gular sac whose ventral wall is without the small secondary sac found in the male *flaviventris;* also, if the sex of the dried skin is correctly identified, the females of the new form possess a definite gular sac, which is entirely absent in the female *flaviventris.* From *nudicluniatus,* which according to De Vis may develop very small wing pouches, it differs in having a much shorter forearm and skull, and by having a conspicuously lighter under surface, instead of the almost uniform colouration found in the latter ally. The shape of the tragus also distinguishes this species, being thicker and more fleshy than the flattened, comparatively simple tragus of *flaviventris,* while it is proportionately longer and not nearly so rounded and thickened as in *nudicluniatus.* Cranially it is distinguished from De Vis' species by having the posterior floor of the mesopterygoid fossa deeply grooved instead of smooth, and by its deeper sphenoid pits with their dividing ridge rising almost to the level of the fossa floor, instead of being much below it as in *nudicluniatus.*

It is readily distinguished from all other forms with wing pouches typical of the genus *Taphozous* by its complete bullae typical of all *Saccolaimus.* Though of about the same size, it differs markedly from the local *T. australis* in the darker colouration of the fur of the back, which is not parti-coloured but brown from base to tip; below the fur is also unicoloured, not being tipped with brown as in *australis.* The

shape of the tragus, and more deeply grooved lip, also serve to distinguish the two forms externally, an additional feature being the larger anterior upper premolar, typical of all *Saccolaimus.*

SACCOLAIMUS NUDICLUNIATUS *De Vis.*

(Plates xlvii-xlviii.)

Saccolaimus nudicluniatus De Vis, Ann. Q'land Mus., No. 6, 1905, pp. 39-40.

Taphozous granti Thomas, Ann. Mag. Nat. Hist. (8) viii, 1911, pp. 378-9.

Diagnosis.—Forearm 71-75 mm. Form stout; digits short and heavy. Gular sac represented in females (Pl. xlvii, fig. 2) by a well defined almost naked area encircled posteriorly by rudimentary pouch edges; no doubt there is a gular sac present in males. Wing pouches absent, or very small (De Vis). Outer base of ear commencing much nearer the tragus base than the corner of the mouth. Lower lip thickened in front, slightly emarginate above, deeply grooved below. Colour above reddish brown, below paler brown. Condylo-basal length of skull 21-23 mm. Hab. North-eastern Queensland and S. Dutch New Guinea.

External characters.—Inner margin of ear commencing above the eye, its lower third concave, thence evenly convex to the tip, not papillate. The upper three-quarters of the outer margin forms a wide-angled convexity, in the lower part of which the ear margin is bent inwards to form a flattened ledge, which is deeply emarginate opposite the tragus, followed by a convex lobe which terminates the outer margin; the outer base reaches to about one-third of the distance between the outer tragus base and the mouth corner. Tragus (Pl. xlvii, fig. 2e) quite circular in its upper outline, peculiarly bulbous above, the front surface of this rounded upper portion concave, the hind surface very convex; covered with minute papillae and scattered hairs. There is a distinct notch at the middle of the outer margin, the rounded upper part of this margin curving inward and downward and ending in a ledge attached to the front surface of the tragus at the middle of its height; the notch is followed by a slight convexity, in its turn followed by a shallow concavity. Other characters as in the diagnosis.

Pelage.—Face in front of the eyes sparsely covered with short hairs; a vertical band of fur behind the eye. External basal third of ear conch furred, the rest naked; inside evenly but sparsely haired. Tragus hairy. Fur of the back extending onto the wing to a line between the proximal thirds of the humerus and femur; posteriorly the long fur does not extend past the femora but ends in a definite line drawn between their proximal ends, about 8 mm. from the tail base. Rest of back and interfemoral membrane sparsely haired. Below the fur is short and thin, the chin is sparsely haired to a level

with the outer ear bases; antebrachial membrane sparsely furred, a post-radial band also present and forming a thickish patch in the radio-metacarpal angle. Proximal third of the humerus covered with dark fur similar to that of the chest; wing membranes covered with lighter longish hairs to a line between the upper halves of the humerus and femur. Fur of the under surface not extending beyond the tail root.

Regarding the colour and external characters of their respective species as given by De Vis and Thomas, the striking similarity is best indicated by tabulating excerpts from each description as follows:—

nudicluniatus.	*granti.*
Colour—	
"back, rich red brown" with "scattered white spots" . . . "hairs white at the extreme base . . . beneath, pale greyish brown."	"above deep reddish brown" . . . mottled with a number of irregular whitish patches; bases of hairs paler. Under surface paler brown."
Gular sac in adult female—	
"represented by a fold of integument and nearly bare skin within its compass."	"represented in female by a sharply defined naked space on the throat, with distinct edges."
Radio-metacarpal pouch—	
"very small or absent . . . minute."	"No radio-metacarpal pouch."

The following table shows the important external and cranial measurements of *granti* to be very much in accord with those given by De Vis, and taken by myself, of specimens of the type series of *nudicluniatus.*

	granti. Type.	*nudicluniatus.* Female cotype.	De Vis' description.
Forearm	71	73.5	75
Head and body	89	92	93.5
Tail	24	26	26.5
Ear	18	19	16
Tragus	5	5	5
3rd Digit—			
metacarpus	67	72	—
1st phalanx	27.5	29.5	29
Skull—			
greatest length	21.7	25.8	—
condylo-basal length	21	23	—
zygomatic breadth	16	17	—
interorbital breadth	7.8	8.5	—
front of canine to back of m^3	10.1	10.8	—

The most important points of disagreement in these dimensions occur in the metacarpus length of the third digit, and greatest length of the skull. The disparity in the metacarpus lengths may quite conceivably be accounted for by variation, measurements of twelve *flaviventris* having shown the phalanges to be very variable at times, even in the same specimen. Regarding the greatest length of the skulls one can only assume there may have been an error in the printing of this measurement in Thomas' description, or else his specimen must be almost devoid of the comparatively strong and overhanging occipital helmet developed in the cranium of the female *nudicluniatus* examined by me. It is difficult to explain how the greatest length of the skull of the *granti* type should be given as only 0.7 mm. longer than its condylo-basal length, unless there was some discrepancy in the taking of the measurement; the measurement taken by myself is from the front of the canines to the posterior end of the occipital helmet. For additional measurements see pp. 340-1.

Skull.—Comparison of the skull (Pl. xlviii, fig. 2a-c) of a female cotype of *nudicluniatus* with Thomas' description of the skull of *granti* shows agreement in every detail, with the exception of the discrepancy noted above. As in *granti*, the forehead is not deeply excavated and the postorbital processes are unusually long, being 1 mm. longer than in the largest skull of *flaviventris*. The median palatal notch (palation) is decidedly posterior to the lateral palatal edges. The posterior part of the floor of the mesopterygoid fossa is smooth, without the deep, sharp, median groove found in *saccolaimus*, *flaviventris*, and *mixtus*. The sphenoid pits are large and not very deep, and their median dividing ridge is comparatively low, not rising nearly as high as the floor of the mesopterygoid fossa. Bullae about as in *flaviventris*, 5.3 mm. long. Lower outline of the mandible decidedly convex beneath the premolars, there being no concavity such as is found in *T. australis*.

Variation.—Thomas described the wing pouches as absent in the type of *granti*, whereas De Vis mentioned that they were either very small or absent; in the latter's cotype examined by me there are very faint but definite traces of rudimentary wing pouches. Otherwise, with the exception of the discrepancy in the skull lengths and the length of the 3rd metacarpus referred to above, the characters of *granti* are strikingly in accord with those of *nudicluniatus*. Regarding any differences which may be apparent, allowance should be made for the fact that the specimens of the latter are somewhat larger than the single specimen of *granti*, and also for variation in the methods of authors in taking measurements, as well as the considerable natural variation of individual specimens. Thomas having failed to mention the extent of the pelage in his type, it is impossible to state whether there is a comparative bareness of the extreme lower back of *granti* as is found in De Vis' specimens.

Localities.—Gowrie Creek, Cardwell, Queensland (De Vis); Paramau, Mimika R., S. Dutch New Guinea, low country (Thomas).

Comparison with allies.—As De Vis pointed out, the nudity of the lower back appears to indicate a slight affinity with *nudiventris,* to which might be added the development of a decided occipital helmet. However, the complete inner sides of the bullae, the hairy abdomen and tragus, and non-papillate ear, and the extension of the fur onto the wing membranes above, definitely distinguishes this form from *nudiventris;* these differences also being maintained by the respective ranges of the two forms. This species is distinguished from *saccolaimus, flaviventris,* and *mixtus* by the absence of the deep groove in the posterior floor of the mesopterygoid fossa and by other cranial characters detailed above, and by its colouration. The peculiarly rounded outline of the tragus and marked thickening of its upper part, also distinguishes this species from its allies, the tragus of *flaviventris* being flattened and comparatively simple, while in *mixtus* though more fleshy, it is not markedly rounded or nearly so thickened above as in *nudicluniatus.*

Conclusion.—When describing his New Guinea species, Thomas was apparently unaware of De Vis' *nudicluniatus,* failing to refer to it in any way, and regarding *saccolaimus* as most nearly allied to *granti.* He stressed certain cranial characters as distinguishing his species from *saccolaimus,* all of which I find to be present in a cotype of De Vis' species. In view of the foregoing, as well as the similarity of the external characters as indicated by the cotype, and De Vis' description, I have no hesitation in regarding *granti* as synonymous with *nudicluniatus.* Additional specimens from New Guinea may show *granti* to be subspecifically distinct and representative of a slightly smaller form, but a large series would be required, and then might only tend further to unite the two forms.

The geographical range of the two might appear to support their distinction, at least subspecifically, were it not for the fact, pointed out by Iredale, that the same species of birds are known to range over both areas. Such evidence of affinity between the birds of the Mimika River and Cardwell areas, considering the strongly volant habits of bats, tends to confirm my conclusion that the species are synonymous.

SACCOLAIMUS SACCOLAIMUS *Temminck.*

Taphozous saccolaimus Temminck, Monogr. Mamm. ii, 1841, p. 285, pl. lx. *Id.,* Dobson, Proc. Zool. Soc. 1875, p. 554, and Monogr. Asiat. Chiropt., 1876, p. 172. *Id.,* Leche, Proc. Zool. Soc. 1884, pp. 52-3. *Id.,* Monticelli, Ann. Mag. Nat. Hist., (6) iii., 1889, p. 489 (synopsis).

Taphozous affinis Dobson, Ann. Mag. Nat. Hist., (4) xvi., 1875, p. 232; Proc. Zool. Soc. 1875, p. 555; Monogr. Asiat. Chiropt., 1876, p. 173. *Id.,* Leche, *loc. cit. Id.,* Monticelli, *loc. cit.*

Dobson wrote that *affinis* was closely allied to *saccolaimus,* which it resembles in general structure and measurements, being distinguished only by its colour and the rudimentary condition of the gular sac in females in which only the margins are developed. The colour of *affinis* was described as black above and white below, as opposed to the dark brown back mottled with irregular white patches, and reddish-brown under surface of *saccolaimus.*

There is a dried skin of a female *Saccolaimus* from North Borneo in the Australian Museum collection which combines the upper surface colouration of *saccolaimus* with the rudimentary gular sac of the female *affinis*, in which only the margins are developed to surround a bare area devoid of any cavity. The fur is dark brown mottled with white above as in *saccolaimus*, while the under surface is creamy white, more nearly approaching the "pure silky white" of the under surface of *affinis;* it is noteworthy that the median line of the under surface is washed with a faint buffy tinge, strongest on the chest and lower abdomen, suggesting a faint tendency to the reddish-brown of the typical *saccolaimus* under surface.

Specimen examined.—Adult female, Australian Museum collection no. M. 45. Purchased from E. Gerrard in 1886.

Variation.—As the specimen from the northernmost range of *affinis* possesses the upper surface colouration of *saccolaimus,* it is possible that the structural character said to separate the two forms may also be variable. In describing *affinis*, Dobson referred to the variability of colour in bats rendering it unreliable alone as a specific difference, but he regarded the rudimentary gular sac of the female as a good specific character. Examination of other species of the group indicates that both the neck and wing pouches may vary considerably, for *T. georgianus* is without the sign of a neck pouch, and the two *S. mixtus* from Port Moresby have small wing pouches typical of the genus *Taphozous.*

Commenting upon the variability of certain characters used to differentiate members of the *Taphozous* group Monticelli (1889) suggested that the size of the feet offered a more consistent diagnostic character. He then presented a modified synopsis of the group and, in addition to the characters I have already discussed, showed *saccolaimus* as having the forearm ranging from 71-73, and the foot from 14-16 mm., contrasted with 65-67 and 17-18 in *affinis*. These figures would seem convincing, suggesting that *affinis* possessed the shortest forearm and the longest foot, were it not that Monticelli appears to have made an error either in taking or arranging his measurements, as shown hereunder. In his catalogue Dobson does not give the forearm length of *saccolaimus*, but that of *affinis* is given as 2.9 ins. = 73.5 mm., and thus the latter would appear to have a maximum forearm length just half a millimeter in excess of that given for *saccolaimus* by Monticelli. Therefore, unless Dobson was in error, Monticelli's key characters break down, *affinis* having both a slightly larger

foot and forearm, and the forearm lengths of the two forms overlapping in a range of only 8.5 mm., which is not excessive for individuals of the one species, as evidenced by the range of 10 mm. in the forearms of my series of ten *flaviventris*. Accepting the forearm lengths as similar, the foot lengths cease to be significant, as Monticelli gives a range of only 5 mm. for the two species, as opposed to 8.5 for the forearms, and again his measurements conflict with those given by Dobson. Therefore, excluding the colour, already shown to be variable, there remains only the rudimentary nature of the female gular sac in *affinis* to distinguish that form, Dobson having stated that the male gular sac of the latter is as large as in *saccolaimus*; he also stated that the female gular sac of the latter is much smaller than in the male, and it therefore seems that *affinis* may prove to be merely a variation of *saccolaimus*.

Range.—Leche (1884) regarded *saccolaimus*, *affinis*, and his *affinis* var. *insignis* as "direct descendants of the same type, which through geographical separation have perhaps gained a certain permanence." He also wrote that "The geographical range of the three above-named forms seems only partly coincident." I have already demonstrated that Leche's *affinis* var. *insignis* is synonymous with *flaviventris*, a species which cannot be confused with *saccolaimus*, or the *affinis* form as hitherto accepted. Regarding the latter two forms, I cannot agree with Leche's conclusion that their ranges are only partly coincident, as the locality of the specimen with the conflicting characters described above, in association with those hitherto recorded for the two forms, indicates that their ranges overlap very considerably.

Dobson recorded *saccolaimus* from Lower Bengal, through Ceylon, Malay Peninsula and Sumatra to Java, and *affinis* from Sumatra. Dobson's other locality for *affinis* was Labuan Island, North Borneo, to which I add the specimen from North Borneo combining features typical of either form

Conclusion.—In view of the conflicting features of the specimen noted above, and the fact that the dimensions and ranges of the two forms evidently overlap, the variability of colouration in these bats, and the inference that plastic characters may also vary, I consider it advisable to regard *affinis* as synonymous with *saccolaimus*, pending the establishment of cranial characters separating the two forms. Possibly examination of a large series from various localities might serve to distinguish *affinis*, meanwhile the only alternative would be to regard it as a variety characterised by the rudimentary condition of the female gular sac, though it is noteworthy that the females of *saccolaimus* have a smaller sac than the males, and therefore the rudimentary condition in the female *affinis* may be merely a matter of degree.

Genus TAPHOZOUS *Geoffroy.*

Taphozous Geoffroy, Descr. de l'Egypte, ii., 1818, pp. 113, 126 (not 1812 as cited by Dobson, or 1813 as given by Miller, proofs only, vide Sherborn, P.Z.S. 1897, p. 285). *Id.*, Monticelli, Ann. Mag. Nat. Hist., (6) iii., 1889, pp. 487-8. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv., 1, 1915, p. 57, and Ann. Mag. Nat. Hist., (9) ix., 1922, p. 266.

Diagnosis.—Bullae incomplete antero-internally, being conspicuously emarginate on the inner sides. Radio-metacarpal pouch always present and well developed. Lower lip scarcely grooved in front. Inner margin of ear papillate. The small anterior upper premolar is proportionately much smaller and its main cusp much lower than in *Saccolaimus*, its crown barely or not reaching the level of the cingulum of canine and large premolar. Lower outline of the mandible markedly concave beneath the anterior premolar in the Australian species.

Genotype.—*T. perforatus* Geoffroy.

Range.—Africa (except north-western portion), southern Asia, East Indies, Philippine Islands, east to New Guinea and Australia.

The Australian species.—The limited number of specimens available, together with details recorded by various authors, enables me to tabulate several striking characters by which *georgianus* may be distinguished from *australis*. Though doubtless somewhat variable, the characters of each form are apparently constant within the limits tabulated in my key, and the available evidence leads to the conclusion that they do not intergrade. So far as one may judge from the meagre details published by Collett, his specimen from Coomooboolaroo, 80 miles south-west of Rockhampton, which he identified as *australis*, presents both the characters and larger dimensions of *georgianus* rather than those of *australis*. Furthermore, though my male of *georgianus* is merely labelled "Dunrobin," the dimensions agree with those of Collett's female, and as there is a Dunrobin 300 miles north-west of Rockhampton, only about 200 miles from Collett's locality, it is very probably the Dunrobin of my specimen. As both Collett's female and the Dunrobin male are evidently referable to *georgianus* rather than *australis*, I am led to the conclusion that the two forms must be regarded as distinct species and not as sub-species, which Thomas considered them to be; *australis* being restricted to the north-eastern coastal regions of Queensland southward to Cardwell, while *georgianus* ranges from about Rockhampton in south-eastern Queensland to the Northern Territory and Western Australia.

The characters of the two species may be synoptically arranged thus:—

A. Gular sac present in male; represented by a naked area with a rudimentary edge in the female. Intertemporal constriction broad, 4.8 — 5 mm., Sphenoid pits short, 3.5 — 3.8. Forearm 61.5 — 66. Tibia 22.8 — 24.5 mm. .... *australis*

B. Gular sac absent in male; no trace of naked area or rudimentary edge in female. Intertemporal constriction narrow, 4 — 4.1. Sphenoid pits long, 4.1—5. Forearm[1] 65—70. Tibia 26—28 mm. ...... *georgianus.*

TAPHOZOUS AUSTRALIS *Gould.*

(Plates xlvii.—xlviii.)

Taphozous australis Gould, Mamm. Austr., iii., 1863 (pt. 6, 1854), p. 32, pl. xxxii. *Id.*, Wagner, Suppl. Schreb. Saugeth., v., p. 690 *Id.*, Dobson, Proc. Zool. Soc. 1875, p. 550, and Cat. Chir. B.M., 1878, p. 382. *Id.*, Ogilby, Cat. Mamm. Austr., 1892, p. 96. *Id.*, Thomas, Journ. Bombay Nat. Hist. Soc., xxiv., 1, 1915, p. 62.

Taphozous fumosus De Vis, Ann. Queensland Mus., No. 6, 1905, p. 37.

Diagnosis.—Forearm 61.5 — 66 mm., averaging smaller than in *georgianus.* Gular sac (Pl. xlvii., fig. 4 a-b.) : in males forming a small but distinct pocket enclosing a naked area in front; in females there is a naked area with a rudimentary edge posteriorly. Intertemporal constriction broader and sphenoid pits shorter than in *georgianus* (see synopsis). Fur bi-coloured: the colour of the tips, in old spirit specimens, of a lighter brown than in *georgianus.* Condylo-basal length of skull 20.2 — 20.5 mm.

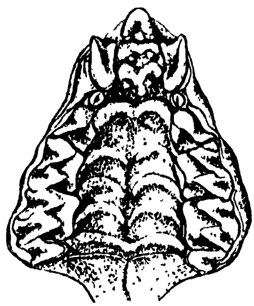


Fig. 2. Palatal ridges of *T. australis.*

External characters.—Ear large, the inner margin papillate and arising above the eye; the outer margin arising opposite, or somewhat below the level of the mouth corner, and nearer the mouth than the tragus base. Tragus (Pl. xlvii., fig. 4e.) large, spatulate and thin, appearing naked to the eye but the microscope shows it to be covered with tiny papillations and short sparse hairs; expanded above, the top

[1] Ostensibly measuring the same specimen, Thomas gives the forearm and metacarpal of the 3rd finger lengths as 3.5 mm. shorter than Dobson's measurements of these parts of the King George Sound female, the forearm according to Dobson being 2.7 in. = 68.5 mm.

is evenly curved and much broader than the base, giving the appearance of a marked concavity of the inner edge. The upper half of its outer margin is almost straight, instead of decidedly concave as in *georgianus;* lower third of outer margin of tragus thickened to form a slight ridge or convexity which does not constitute a lobule. The frontal depression is strongly marked and there is a groove under the eye. Lower lip not grooved in front, but terminating anteriorly in a naked triangular area on each side of the centre, separated by a sparsely haired area. Palatal ridges (Fig. 2) five, the first and last complete arches, the others divided by a central depression; the hindmost ridge is more complete than in *georgianus.* Measurements on pages 340-341.

Colour and variation.—Lack of fresh skins obviates a satisfactory colour description, but in wet or dried old spirit specimens the bicoloured nature of the pelage of both surfaces is always discernible Gould, quoting MacGillivray, described the basal half of the fur as white, and it is certainly whitish, though in old spirit specimens, wet or dried, I consider the basal half of the fur creamy, rather than pure white, on both surfaces. Dobson, doubtless describing the somewhat darker coloured female *georgianus,* gave the terminal half of the fur as dark brown above, and paler below. In a dried old spirit skin from Cape York, the general colour of the back is a light sayal brown with a fawny tinge, the head being much lighter; under surface a pale shade of fawny brown.

Lacking fresh material, I am permitted to follow Gould's example in quoting MacGillivray's notes "taken on the spot":—"Colour (there are two varieties): above, ferruginous brown; light brown in the centre of the back and across the abdomen; or entirely brownish grey; basal half of the fur white; below, ash-grey, with sometimes a slight reddish tinge; muzzle black." The two varieties of colour refer to the upper half of the fur, the whitish basal half being quite consistent on both surfaces.

Pelage.—Fore part of head sparsely haired to a convex line drawn between the eyes, as is the chin to a line drawn between the mouth corners. A slight tuft of fur behind the eyes. Inner margin of ear fringed with hair within; fur extending onto lower quarter of base externally, the remainder of the ear either naked or very faintly haired inside and out. Fur extending onto the wing membranes above and below to a line drawn between the proximal thirds of the humerus and femur. Above, the interfemoral membrane is furred to a line with its perforation by the tail; below, the dense fur does not extend beyond the anus and femora, the membrane being but sparsely furred posteriorly. Antebrachial membrane naked on both surfaces, excepting close to the shoulder.

Skull (*Pl.* xlviii., *fig.* 4 a-c.).—Frontal area deeply excavate, decidedly more so than in the three species of *Saccolaimus;* interorbital region flattened, the outline of its edges markedly concave. Palation about level with the lateral palatal edges, within 0.5 of a mm. Posterior floor of mesopterygoid fossa deeply grooved. Sphenoid pits deep, their median dividing plate rising as high as the floor of the mesopterygoid fossa. Intertemporal constriction markedly broader, and sphenoid pits shorter than in *georgianus* (see synopsis), though subject to slight variation in individuals. Thomas has recorded the width of the constriction as uniformly just 5 mm., and the length of the sphenoid pits as 3.5 mm., whereas in a specimen from Cape York and one of De Vis' *fumosus* the measurements are 4.8-4.9, and 3.7-3.8 respectively. Owing to the greater constriction width, and the width of the brain case at the zygomata being equal to that of the larger *georgianus*, the cranium appears more inflated than in the allied species. Anteriorly the sphenoid pits are rounded and do not reach the level of the large vacuities outside the nasal cavities, but end about a millimeter from them, whereas, in *georgianus* the sphenoid pits are narrowed anteriorly and reach forward to the level of the vacuities. Saggital crest weak, not reaching to the occiput as in *georgianus.*

Synonymy.—Thomas has shown that Gould's specimens from Cape York are the cotypes of *australis*, and not the King George Sound female, regarded as the type by Dobson and which Thomas made the type of his subspecies *georgianus.*

In 1905 De Vis described *T. fumosus* based upon four specimens from Cardwell, Queensland, which he distinguished from *australis* by various characters. After analysing these characters, and comparing his typical material with topotypical and definite *australis*, I have no doubt that the two species are synonymous. Dobson listed only the one adult female, from Western Australia, and it was doubtless this specimen which prompted him to state that there was no trace of the gular pouch in females of *australis*, and that the chin was covered with hairs in the position of the gular sac in males. Misled by Dobson's description of this character, typical of the *georgianus* form, De Vis regarded the presence of a rudimentary gular sac in his Cardwell females as a specific character separating them from *australis;* however, an examination of five topotypical *australis* females shows them to have the rudiments of the gular sac equally as well developed as in the female co-types of *fumosus.*

Other characters relied upon by De Vis to distinguish *fumosus* were:—(1) a lobule on the tragus; (2) a much shorter forearm and tail; (3) colour. Upon examining De Vis' material, in comparison with a series of twelve *australis* from Cape York and Cooktown, and two *georgianus* from Derby, W.A., I find none of the characters sufficient to confirm the identity of *fumosus*, for the following reasons:—

(1) The tragi of De Vis' specimens conform in detail to those of *australis*, the "shallow lobule" described by him being merely a thickening of the lower outer margin, equally well developed in all my specimens of *australis*. This thickened convexity is slightly less marked in my specimens of *georgianus*, and Dobson was apparently describing this form when he stated that there was no lobule at the tragus base. The structure does not constitute a lobule as usually accepted by Dobson, and being exactly similar in the typical *fumosus* and Cape York *australis*, cannot be regarded as a distinctive character.

(2) Dobson apparently quoted a large specimen of *georgianus* in giving the forearm length of *australis* as (2.7 ins.) 68.5 mm., leading De Vis to suppose that his specimen with a forearm of 63.5 mm. represented a species with "a much shorter forearm." However, my series of *australis* have forearms ranging from 61.5-66 mm., and the four *fumosus* forearms, as taken by myself, measure within these limits.

Dobson gave the tail length as (1.3 ins.) 33 mm., and De Vis concluded that his specimen with a tail length of 25.5 mm. represented a species with a "much shorter" tail. Apparently measuring the same specimen as Dobson, Thomas gives the tail length of the female type of *georgianus* as 25 mm., so that allowance must be made for individual methods of measurement, and for the variable nature of the character. However, the tails of my series of *australis* range from 25.5 to 28.5 mm., and the tail lengths of *fumosus* fall within this range.

(3) De Vis' colour description of *fumosus* recognizes the bi-coloured nature of the fur, but he apparently regarded his species as darker than *australis*. The fur of the *fumosus* series is almost black in alcohol, but the uniformly bad condition of the specimens suggests that the colouration has been affected by delayed, faulty, or over strong preservation. The membranes are perished, splitting or peeling in parts, and are not uniform black as De Vis described them, nor are the ears, both showing definite traces of the yellowish colour typical of the integument of spirit specimens of *australis*. In view of the similarity in all the plastic characters, I do not consider the apparently abnormal colouration of De Vis' specimens of specific significance.

A detailed comparison of the skull of one of De Vis' cotypes with a skull from Cape York shows them to agree in all their characters, m^3 and the palatal ridges also being exactly as described by De Vis.

Locality and history of cotypes.—Gould's specimens were from "the maritime caves in the sandstone cliffs of Albany Island, Cape York. In great numbers in three of the caves. Specimens obtained October, 1848." Collected by John MacGillivray, the naturalist attached to H.M.S. "Rattlesnake" during a survey of the northern coast of Australia.

Specimens examined.—A series of eleven specimens from Cape York (Macleay Museum); De Vis' type series of *fumosus* (Queensland Museum); also a male from Cooktown, no. M.876 in the Australian Museum collection, presented in 1893 by the late Dudley Le Souëf.

Localities.—Albany Island, Cape York; Cooktown and Cardwell, northern Queensland, New Guinea (Dobson).

Distribution.—In his catalogue Dobson lists an adult male from New Guinea presented by Mrs. Stanley, which Thomas did not refer to in describing his subspecies. This specimen is of interest regarding the range, and the specific identity of the New Guinea form, as it occurs to me that it may prove to be an example of the *Saccolaimus mixtus* described above. The known range of *australis*, in Australia, is the coastal region of northern Queensland from Albany Island, Cape York, to Cardwell, and the species therefore appears to inhabit the Cape York Peninsula, extending only about fifty miles southward of that area to Cardwell.

Conclusion and comparison with allied species.—I consider that none of the characters used to distinguish *fumosus* are maintained, and have no hesitation in regarding it as synonymous with *australis*.

This species may be readily distinguished from *georgianus* by the possession of a gular sac in males, and a naked area and rudimentary edge in the gular region of females, whereas there is no trace of a gular sac in either sex of *georgianus*, the region being sparsely covered with hair. The broad intertemporal constriction (4.8-5 mm.), and the shorter sphenoid pits, which are broadly rounded anteriorly, serve to distinguish skulls of *australis*.

TAPHOZOUS GEORGIANUS *Thomas.*

(Plates xlvii-xlviii.)

Taphozous australis Collett, Zool. Jahrb. (Syst.), ii, 1887, p. 849.

Taphozous australis georgianus Thomas, Journ. Bombay Nat. Hist. Soc., xxiv, 1, 1915, p. 62.

Diagnosis.—Forearm 65-70 mm., averaging larger than in *australis*. Gular sac absent in both sexes (Pl. xlvii, fig. 5 a-b.), the gular region being sparsely haired. Intertemporal constriction narrower, and sphenoid pits longer than in *australis* (see synopsis). Fur bicoloured, the upper half, as far as discernible in old spirit specimens, of a darker brown than in *australis*. Condylo-basal length of skull 21-21.4 mm.

External characters.—Other than those in diagnosis, apparently as in *australis*, excepting that the outer margin of the tragus (Pl. xlvii, 5e.) is not so straight, being decidedly concave in its upper half, and the hindmost palatal ridge tends to a division in the centre like the three intermediate ones, instead of being complete, as in the typical form. Under microscopic examination the location of the gular sac, in the largest female, is but faintly indicated by the texture of the skin and sparseness of the hair. Measurements on pages 340-341.

Colour.—Lack of fresh skins renders a satisfactory description impossible. In three old spirit specimens the bicoloured nature of the pelage is clearly discernible on the upper surface, but not so well defined below; these specimens also indicate that the general colour is somewhat darker than in *australis*. Probably describing the King George Sound female, Dobson gave the terminal half of the fur as dark brown above, paler below, and the basal half as "above and beneath pure white." According to Collett his specimen was "a light greyish brown, the base of the fur whitish, but not pure white as in Dobson's specimen. The lower surface is coloured as the upper." Though my old spiritous material may be considerably stained, I consider the basal half of the fur yellowish-white or creamy, rather than pure white, thus conforming more to Collett's description.

Cranial characters.—Intertemporal constriction (Pl. xlviii, fig. 5a-e.) markedly narrower (4-4.1 mm.), and sphenoid pits longer (4.1-5) than in *australis*; owing to the noticeably narrower constriction width, and the width of the brain case at the zygomata being barely equal to that of smaller skulls of *australis*, the cranium appears less inflated than in the allied form, producing a material difference in the general aspect of the skull. Sphenoid pits pear-shaped, their narrowed anterior ends reaching forward to the hind level of the large vacuities outside the nasal cavities, whereas in *australis* the pits are broadly rounded anteriorly and end about a millimeter from the vacuities. The length of the pits appears to be subject to considerable variation, ranging from 4.1-5 mm. in one male and two female crania which are of equal size to within a millimeter. Saggital crest weak but reaching to the occiput, instead of fading out as in *australis*.

Variation in authors' descriptions of type.—Though they were apparently reviewing the same specimen there are discrepancies in the dimensions given by Thomas and Dobson which may be due to individual methods of measurement. Thomas gives the forearm length as 65 mm., and that of the 3rd finger metacarpal as 60, which according to Dobson are 68.5 and 63.5 respectively. The tail length according to Thomas is 25, Dobson giving it as 33 mm. However, in two specimens from Derby, W.A., the tails measure 28.5-32 mm., showing that the length of the tail varies considerably. The forearms of the two latter measure 66-69.5 mm.

SPECIMENS EXAMINED.

In describing the female type of his subspecies, Thomas stated that the rudimentary indications of a gular sac are less perceptible than in females of the typical *australis*. Two female *georgianus* from Derby, W.A., have the gular region covered with hair as described by Dobson, who was evidently describing the King George Sound specimen as it was the only female listed by him; the sex of the cotypes of the species was apparently not determinable as Dobson listed them merely as "ad. sks."

Collett's specimen.—Collett gave only a brief colour note and a few dimensions of the female from about 80 miles south-west of Rockhampton which he recorded as *australis*, but all the dimensions conform to those of the larger Western Australian form as represented by my Derby females, and the Dunrobin male. He gives the forearm length as 70 mm., which is half a millimeter in excess of the forearm of my largest female from Derby, and one millimeter longer than the forearm of the Dunrobin male; it also exceeds the longest *australis* forearms by 4 mm. The length of the tibia 28 mm., agrees with the dimensions (26-27) of *georgianus*, rather than with those of the tibiæ of *australis* (22.8-24.5). The length of the tail, though evidently subject to variation and differences in measuring methods, is compatible with that of *georgianus*. The zygomatic breadth of the skull (14) is 0.2 mm. larger than my largest *georgianus* (13.6-13.8), thus emphasising the disparity between it and *australis* (13). The length of the skull (24) given by Collett is in excess of the length from the occipital helmet to the front of the canine (22-22.3) of my largest *georgianus*, but this is accounted for by the fact that the author probably took his measurement to the extreme tips of the canines, as by so doing the skull length of my largest Derby female is also 24; in any event the larger dimension indicates affinity with *georgianus*.

The Dunrobin male.—According to Thomas, a male which originally accompanied the type disappeared afterwards, and therefore the characters of the male have not hitherto been described. I have recently discovered an adult spiritous male in the unregistered old collection of the Australian Museum (now M.3509) on the label of which is written "Dunrobin, 2.6.'67"; unfortunately the place is not localised, and would remain in doubt save for indications set out below tending to associate it with the Queensland Dunrobin. Of the identity of the specimen, however, I have no doubt, as careful comparison of it with the Derby females shows them to agree in all cranial and external characters. Furthermore, in the male, unlike in *australis*, there is no trace of even the rudimentary edge of a gular sac or a naked area, such as is found in females of the latter form, instead the gular region is sparsely but evenly covered with short hairs as in the *georgianus* females. The dimensions of this male with a forearm length of 69 mm. are in close accord with those of a Derby female with a 69.5 forearm, while both are reconcilable with

Collett's female from near Rockhampton with a 70 mm. forearm. In fact so well do the dimensions of the Dunrobin male accord with Collett's female, that I consider it reasonable to assume that the locality is identical with the Dunrobin situated about 300 miles north-west of Rockhampton, and approximately 200 miles from Collett's locality.

Locality and history of type.—Thomas founded his subspecies primarily on specimen *d* of Dobson's Catalogue, an adult female in spirit, from King George Sound, Western Australia, presented to the British Museum by Sir John Richardson. This specimen was regarded by Dobson as the type of Gould's species but, as Thomas pointed out, *australis* was founded on two specimens from Albany Island, Cape York, which are Dobson's *b* and *c*, the cotypes of the species.

Localities.—King George Sound (type) and Derby, Western Australia; Mary River, Northern Territory; Coomooboolaroo, 80 miles south-west of Rockhampton, Queensland. The male from "Dunrobin," the location doubtful, but believed to be the Dunrobin 300 miles north-west of Rockhampton.

Distribution.—In view of the above the species range is from King George Sound, Western Australia, to the Mary River in the Northern Territory, and eastward to near Rockhampton in Queensland.

It is regrettable that the locality of the only male of the species so far retained should be in any doubt. However, though there is a Dunrobin in both Victoria and South Australia, the complete agreement of the dimensions of the Dunrobin male with Collett's female from the Rockhampton area, renders it reasonable to suppose that the locality is the Dunrobin situated between the Great Dividing Range and one of its spurs, about 80 miles west of Clermont and 300 miles inland from Rockhampton, Queensland. Iredale has pointed out to me the dissimilarity of the species of birds inhabiting the Cape York Peninsula and the Rockhampton regions, and the ranges of the two species of *Taphozous* appear to support his contention. Though widely distributed, *georgianus* does not seem to extend far north of Rockhampton, and there are no records of *australis* south of Cardwell so that, pending further records, we have two forms representing two well defined geographical areas.

Comparison with allied species.—The species is readily distinguished from *australis* by the absence of any trace of a rudimentary gular sac in either sex, even the naked area and rudimentary edge found in females of *australis* is absent, the gular area being evenly but sparsely covered with hairs. The narrower intertemporal constriction (4-4.1 mm.) and the longer sphenoid pits, which are narrowed anteriorly, serve to distinguish skulls of *georgianus*.

Table of measurements of *S. mixtus* and *nudicluniatus*, and *T. australis* and *georgianus*.

	mixtus		*nudicluniatus.*	*T. australis*					*T. georgianus*			
	A. 3257-8 Port Moresby		J. 1947. Cardwell.	M. 876. Cooktown.	Cape York, Q. In Macleay Museum.		*tum sus* cotypes. Cardwell. Q		Dunrobin.	Derby, W A.		*australis*, *vide* Dobson, = *georgianus*
	Type. Male.	Allotype. Female	Cotype, Female.	Male.	Male.	Females	Male.	Female.	Male.	Females.		
Forearm	61 5	62.5	73.5	61.5	64	63.5—66	63.5	65	69	66	69.5	68.5
2nd Digit—Metacarpal .	56.5	56.5	66	52.5	54	52.5—55	53	54.5	58	54.5	57 5	......
3rd Digit—												
Metacarpal	60.5	60.5	72	56.5	58	56.5—60	56	58 5	62.5	60	63	63.5
1st phalanx .. .	23	23	29.5	19	19	19.5—21	18.5	19.5	22	20 5	22	20.5
2nd phalanx	23.5	22	30	22.5	22 5	22.5—23	21.5	22	25	24.5	28	28
4th Digit—												
Metacarpal	45	46	52	44.5	45	44 —47	43.5	46 5	50	48 5	50.5	. .
1st phalanx	16.5	17.5	21.5	12.5	13 5	13.5—14	12.5	13.5	15	14.5	15	. ...
2nd phalanx	4	6.5	7.5	9.2	9.5	9 —10	9.3	9.5	11	9	10.3	......
5th Digit—												
Metacarpal	31	32	37.5	35 5	36	35.5—37.5	36	37.5	42	40	40.5	
1st phalanx	14.5	15	18	13	13.5	13 —13.5	13	13.2	15	14.5	14.3	62.5
2nd phalanx	8.5	7 & 10	12	7 5	8	7.7— 8.5	8	7.5	9	8.2	9	
Tragus—												
Length from base ...	4.5	.. ...	5	5.8	5.5	5 8— 6.5	5.3	5.5	6.5	5.8	6.5	7
Width of top	3.2	.. ..	4	5	5	5.2— 5.4	....	4.9	5.2	5 3	5.5	. ...
Ear—												
Length from outer base	20	... .	19-20	23	22	22 —22.5	21	22	23	21.5	23	24.2
Max. breadth flattened	14.3	......	14	... ..	16	16 —15	13 5	15.5	......	16.5	15	... .
Tail—												
Total length	23	26	26	27	25.5	25.5—28.5	26.5	26.5	. ...	28.5	32	33
Free portion	9	11	13	12	13	14.5—13.5	11.7	12	12	15	12.5	.. .
Tibia	23.5	23	27.5	23	23	22.8—24.5	24	24	27	26	26.5	26.5
Foot—c.u.	12	11	16	10	10 2	9.8—10	9.9	9.8	11	10.3	10.5	11.5
Corner of mouth to outer ear-base.	3.5	4	7.5	3.3	3	3.2— 3.8	4	4	5	4 8	4.3	......
Head, from outer tragus-base to nose-tip ...	20.5	.. ...	......	19	19	18.5—19	18.5	19.5	... ..	21	20	......

Table of cranial measurements of *Saccolaimus* and *Taphozous*.

	S. flaviventris.			*S. mixtus.*		*S. nudicluniatus.*	*T. australis.*		*T. georgianus.*	
	No. 137. Type. Male.	M. 918. Moree. Male.	*hargravei.* Type. Female	Two Skulls. Port Moresby.		Female. Cotype. Cardwell. Queensland.	Cape York. Male.	*fumosus.* J. 1950 Female Cotype. Cardwell.	Male. Dunrobin. Australian Museum.	Female. Derby. Macleay Museum
Basal length	23.5	23	22.5	18.3	18.5	21	18.5	18.2	19.5	19.5
Condylo-basal length	25	25.4	24.5	20.5	20.5	23	20.5	20.2	......	21.4
Occip. helmet to front of canine	26.6	26.5	25.4	22	21.9	25.8	21.4	21.4	22	22.3
Zygomatic breadth	17.8	17.6	16.5	......	......	17	13	13	13.8	13.6
Palatal length	11.5	11	10.5	9	9	10.5	8 5	8.5	9	9.1
Interorbital breadth	9.5	9.1	8	7.7	8	8.5	6.4	6	6.4	6.5
Postorbital process	5	4.9	......	......	......	6	3.7	... ..	3.8	3.7
Sphenoid pit length	3.8	3.9	3 4	4.2	4.2	4.2	3.8	3.7	4.6	5
Brain-case at zygomata—width	12	12	11.3	10.5	10.5	12	10	9.8	9.8	9.5
Intertemporal constriction ...	6	5.7	5	5.7	5.5	5.3	4.9	4.8	4.1	4
Bulla length	5.5	5.5	5.2	4.7	4.8	5.2	4.6	5	5	5.3
Maxillary tooth-row	11.8	11.8	11.5	9.2	9	10.8	9.3	9.1	9.8	9.5

SOME LITTLE KNOWN AUSTRALIAN FLAT-FISHES.

By

ALLAN R. MCCULLOCH, Zoologist, and G. P. WHITLEY, Assistant in Zoology, Australian Museum.

(Plate xlix and Figures 1-4.)

Large collections of fishes, resulting from the operations of the Federal Investigation Trawling Ship "Endeavour," include a considerable number of flat-fishes, Heterosomata. These have been sent to Mr. J. R. Norman, of the British Museum, who has generously undertaken to examine and report upon them, and at the same time, to revise all species of the order known from Australian waters.

To assist him so far as possible, representatives of all species available to us have been submitted for his examination. A few species, however, are known from their holotypes only, no other specimens having been recognised since they were first characterised by Sir William Macleay, C. W. De Vis, and Mr. J. Douglas Ogilby. The risk of damage to, or even loss of these unique specimens forbids their transport to and from London, so we have redescribed and figured them here, and have added notes suggesting their identity with, or close relationship to other species. It is hoped that our paper will be published in time to enable Mr. Norman to refer the species to their proper places in his revision.

Family BOTHIDAE.

ENGYPROSOPON *Günther, subg.* SCAEOPS *Jordan & Starks.*

Engyprosopon Günther, Brit. Mus. Cat. Fish. iv, 1862, pp. 431, 438 (*Rhombus mogkii* Bleeker). *Id.* Hubbs, Proc. U.S. Nat. Mus. xlviii, 1915, p. 457. *Id.* Regan, Ann. Durban Mus. ii, 5, 1920, p. 210.

Scaeops Jordan & Starks, Bull. U.S. Fish. Com. xxii, 1904, p. 627 (*Rhombus grandisquama* Schlegel), and Proc. U.S. Nat. Mus. xxxi, 1906, p. 168.

Synonymy.—Jordan and Starks (1904) relied upon the size and nature of the scales, dentition, form of the gill-rakers, and later (1906) upon the breadth of the interorbital space to distinguish their genus *Scaeops* from *Engyprosopon.* In 1915, Hubbs united these two genera because the supposed differences in the teeth and gill-rakers

proved to be either invalid or bridged by several species which he enumerated. Regan (1920) likewise included *Scaeops* in the synonymy of *Engyprosopon.* Deciduous or adherent scales of larger or smaller size, in themselves, are unsatisfactory as differentiating characters of closely allied genera, so the width of the interorbital space alone remains to separate *Engyprosopon* and *Scaeops.* In such species as *poecilurus* Bleeker and *natalensis* Regan, the interorbital width is about midway between the extremes of *mogkii* Bleeker, and *grandisquama* Schlegel. It actually varies in the two sexes of some allied species, and changes considerably with growth. It therefore seems that all the characters of *Scaeops* merge into those of *Engyprosopon*, and the former can be maintained only as a subgenus of the latter.

ENGYPROSOPON, SCAEOPS, GRANDISQUAMA *Schlegel.*

(Figure 1.)

Rhombus grandisquama Schlegel, Faun. Japon., Pisces 1846, p. 183, pl. xcii, figs. 3-4.

Rhomboidichthys grandisquama Gunther, Brit. Mus. Cat. Fish. iv, 1862, p. 437.

Scaeops grandisquama Jordan & Starks, Proc. U.S. Nat. Mus. xxxi, 1906, p. 168, fig. 1.

Rhomboidichthys spiniceps Macleay, Proc. Linn. Soc. N.S.Wales vi, 1881, p. 127.

D. 87; A. 65; V. dex. et sin. 6; P. 11; C. 17. 43 scales on the lateral line between its origin at the shoulder-girdle and the hypural joint, and 3 or 4 more on the base of the tail.

Total length 115 mm. Head (23 mm.) 4.1 in the length to the hypural joint (95); the greatest breadth (50) is a little in advance of the middle of the length and is 1.9 in the length to the hypural joint. Upper eye (7) 3.3 in the head, and 1.2 in the interorbital width (9), which is 2.5 in the head.

Body rather broad· the anterior profile of the head rises in a steep curve from a shallow notch at its junction with the snout. A large obtuse spine near the end of the snout projects obtusely forward and upward; a similar but shorter spine is present at the antero internal angle of each eye, and a bony knob a little behind the mandibular symphysis. Nostrils of upper side separated by a narrow interspace, and on the same level as the upper margin of the lower eye; the anterior is in a short tube with a posterior membranous flap, the posterior with scarcely raised margins: the nostrils of the lower side similar but much smaller. Eyes rather large, separated by a broad scaly interspace; their inner margins are defined by raised

bony crests, and the lower is separated from the mouth by a narrow preorbital bone. The lower eye is considerably in advance of the upper, its posterior margin being on the same level as the middle of the upper eye. Mouth oblique, maxillary terminating a little farther back than the anterior margin of the lower eye. Upper and lower premaxillaries with an outer row of somewhat enlarged teeth, which are fixed and widely spaced, and an inner row of close-set depressible teeth. (Gunther (1862), and Jordan & Starks (1906) described the teeth as uniserial, but Hubbs (1915) states that they are biserial.) Mandibles with a single row of depressible teeth on each side. Gill-opening of upper side extending upward to a point midway between the pectoral fin and the origin of the lateral line. Inferior and lower portion of the posterior preopercular margins exposed. Gill-rakers short and thick; six are present on the lower limb of the first arch of the left side, but none on the upper limb.

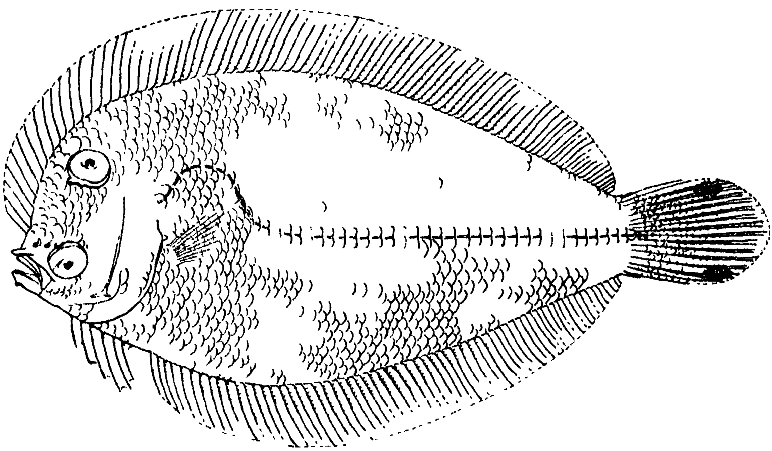


Figure 1.
Engyprosopon grandisquama Schlegel. Holotype of *Rhomboidichthys spiniceps* Macleay, 115 mm. long, from Port Jackson, New South Wales.

Upper surface of head and body entirely covered with rather large scales which appear to be cycloid, but have a larger or smaller number of microscopic cilia along their edges. They extend onto the fin-rays, but do not cover the intermediate membranes. The scales of the lower surface are cycloid. Lateral line developed on the upper side only, originating behind the shoulder-girdle and extending backward onto the caudal fin; it forms a very convex curve anteriorly, the width of which is 3.3 in the straight portion.

Dorsal fin originating on the lower surface of the snout a little in advance of the notch, and terminating a little before the hypural joint; the rays are simple and longest above the middle of the body, 2.3 in the head. Anal rays similar to those of the dorsal opposite them and terminating in advance of the hypural joint. Pectorals well developed on each side, but imperfect in the specimen described. The right ventral fin originates a trifle behind the end of the isthmus and extends along the ridge of the abdomen; the interspace between the last ventral and first anal rays is 1.4 in the diameter of the eye and is occupied by a flat bony extension of the pelvic girdle. The left ventral is much smaller than the right, its base being little more than one-third as long as that of its fellow. It springs from the under-surface of the abdomen, originating almost opposite the fifth ray and terminating behind the last ray of the right ventral. The vent is on the under-surface, a trifle before the first anal ray. Caudal rounded, most of its rays branched.

Colour.—According to Macleay, the colour was "brownish-red, faintly mottled all over with blackish, two larger black spots on the caudal fin, one on the upper, the other on the lower edge, behind the middle." The specimen is now almost completely faded, but traces of the black mottling are visible and the caudal spots are distinct.

Described and figured from the holotype of *Rhomboidichthys spiniceps,* 115 mm. long, which is preserved in the Macleay Museum.

Synonymy.—*Rhomboidichthys spiniceps* appears to be synonymous with *Engyprosopon grandisquama.* Macleay's holotype is a trifle narrower than any of a series of twenty-eight specimens obtained by the Federal Trawler "Endeavour," which are duplicates of others sent to Mr. Norman. In these the width varies from 1.6 to 1.8 in the length to the hypural joint, whereas it is 1.9 in Macleay's specimen. The proportions of the holotype are very similar to those of Jordan & Starks' figure of *E. grandisquama,* and as all other structural details and colour-marking are similar to those of the Japanese fish, we believe the two are identical.

Localities.—Macleay's holotype was said to have been obtained in Port Jackson, but as no other specimen has been captured so far south, it must be regarded as a mere straggler from the north. The greater number of the "Endeavour" specimens are unfortunately without data, but four are entered in the register as from northern New South Wales.

(ARNOGLOSSUS) BLEEKERI *Macleay*.

(Figure 2.)

Arnoglossus bleekeri Macleay, Proc. Linn. Soc. N.S.Wales vi, 1881, p. 124.

D. 93; A. 70; V. dex. et sin. 6; P. 12; C. 17. Lateral line imperfect; the number of tube-bearing scales is estimated at 51.

Total length 73 mm. Head (14 mm.) 4.5 in the length to the hypural joint (63.5); the greatest breadth (32) is a little in advance of the middle of the body, and is 1.9 in the length to the hypural joint. Interorbital space (0.5) 8 in the upper eye (4) which is 3.5 in the head.

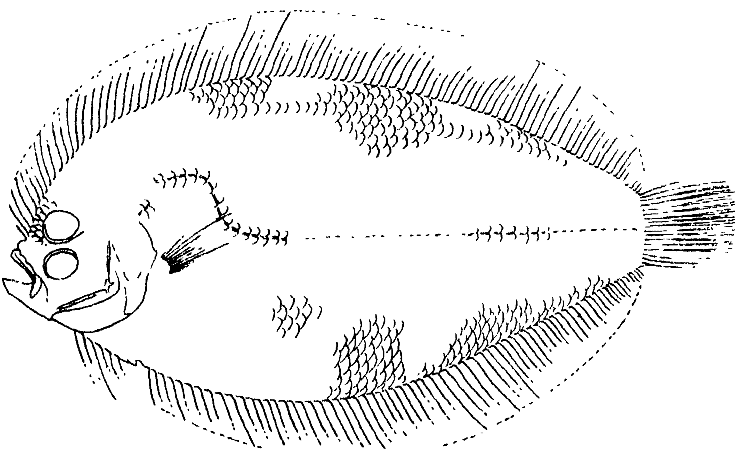


Figure 2.

Arnoglossus bleekeri Macleay. Holotype, 73 mm. long, from the Endeavour River estuary, north Queensland.

Body rather broad; the upper anterior profile forms a strongly convex arch arising from a shallow notch at its junction with the snout. The anterior nostril on the upper surface minute, with raised dermal margins; the posterior a simple opening close to the antero-superior margin of the lower eye; lower nostrils similar in position and form to the upper ones. Eyes separated by a very narrow groove; their inner and anterior margins are bony ridges, and the inner edge of the upper eye is produced obliquely backward towards the preopercular margin. The lower eye is in advance of the upper by about one-fourth of its length, and is separated from the mouth by a narrow

preorbital bone. Mouth oblique; the maxillary reaches a trifle behind the vertical of the anterior margin of the lower eye. Premaxillaries of both sides with two rows of small fixed teeth anteriorly and a single row on the sides. Mandible damaged, but the teeth appear to have formed only a single row. Gill-opening of upper side extending upward to a point a little nearer the origin of the lateral line than the pectoral fin. The lower margin and the lower portion of the posterior margin of the preoperculum free. There appear to be six gill-rakers on the lower limb of the first arch, but none on the upper; they are moderately slender, subequal in length, and about 0.5 mm. long.

Most of the scales have become detached, but the upper and lower surfaces of the head and body were evidently entirely covered by rather large cycloid scales. They apparently extended onto the fin-rays, as in allied species. Lateral line incomplete, developed on the upper side only; it forms an angular arch anteriorly, the width of which (9 mm.) is 4.4 in the remainder of its length to the hypural joint (40).

Dorsal fin originating beneath the upper margin of the snout a little in advance of the notch, and terminating a little before the hypural joint; all the rays are simple, longest above the middle of the body. Anal rays similar to those of the dorsal opposite them, and terminating a little in advance of the hypural joint. Pectorals well developed on each side, but imperfect in the specimen described. The right ventral fin originates near the end of the isthmus and extends along the ridge of the abdomen; the interspace between the last ventral and first anal rays (3 mm.) is 1.3 in the diameter of the eye, and is occupied by two flat spine-like extensions of the pelvic girdle. The left ventral is much smaller than the right, its base being little more than one-third as long as that of its fellow; it springs from the under surface near the margin of the abdomen, originating opposite the interspace between the fourth and fifth, and terminating behind the last ray of the right ventral. The vent is on the under surface close to the base of the first anal ray. Caudal incomplete, most of its rays branched.

Colour.—Macleay describes the colour as "uniform pale reddish-yellow, a spot on the upper part of the operculum." The holotype is now completely faded.

Described and figured from the holotype of *Arnoglossus bleekeri* Macleay, 73 mm. long, which is preserved in the Macleay Museum.

Locality.—Endeavour River estuary, Cooktown, Queensland.

Family PLEURONECTIDAE.

Subfamily SAMARINAE.

SAMARIS CACATUAE *Ogilby.*

(Plate xlix.)

Arnoglossus cacatuae Ogilby, New Fish. Qld. Coast, 1910, p. 130.

D. 13/73; A. 59; P. 4; V. 5; C. 16. 63 scales above the lateral line from its anterior branch to the hypural joint; about 20 rows between the back and the lateral line at the widest part, and about 22 more to the ventral edge.

Head (26 mm.) 5.1 in the length to the hypural joint (134). Depth (53) 2.5 in the same. Lower eye (7) longer than its distance from the end of the snout. Sixth dorsal ray (94) 1.4 in the length to the hypural joint. Pectoral fin (32) 4.2, first ventral ray (32) 4.2, and caudal (36) 3.7 in the same.

A notch before the middle of the upper eye on the anterior profile marks the commencement of the dorsal fin. A free membranous flap commences on the base of the first ray and extends around the lower surface of the head to the angular prominence of the lower jaw. Mouth somewhat asymmetrical, the upper maxillary larger than the lower and reaching backward to below the anterior portion of the lower eye; it is somewhat expanded above and terminates in a rounded lobe. Mandible projecting a little beyond the upper jaw. A band of villiform teeth in each jaw which is as well developed above as below. Palate apparently toothless. Upper nostrils in two divergent tubes overhanging the upper lip. Interorbital space narrow, with a median bony ridge; the upper eye a little in advance of the lower. Preoperculum forming an obtuse angle, only the posterior portion of its margin free. Operculum extending backward as a rounded lobe. Gill rakers very short and broad.

Lateral line almost straight from above the preoperculum to the base of the tail. Body entirely covered with ctenoid scales, which extend forward almost to the level of the anterior margins of the eyes and onto the interorbital space; they extend over the bases of the caudal rays, but leave the other fins naked. Scales of lower surface cycloid. Vent a large opening before the anal fin.

The anterior thirteen dorsal rays are greatly elongate, and are connected by membrane only at their bases; the sixth to tenth are longest. The succeeding rays increase gradually in length backward to the 64th, after which they become suddenly and abruptly shorter.

A membrane connects the 66th with the base of the tail, and covers the bases of the posterior dorsal rays. Anal without prolonged rays, similar in form to the major part of the dorsal and with a similar membrane posteriorly. Ventrals somewhat asymmetrical, the upper extending along the ridge of the abdomen and connected with the anterior anal ray by membrane; its anterior ray is free, elongate, and terminates in a racquet-shaped appendage; the succeeding rays are united by membrane, and the second to fourth have racquet-shaped tips. The left ventral is formed of five rays, of which the median are longest, and a membrane unites the last with the anterior edge of the vent. Upper pectoral elongate, composed of four simple rays, the two upper of which are curved at their tips; no pectoral fin on the blind side. Caudal rays simple, the median longest.

Colour.—Light brown in preservative with a row of five dark, circular spots extending around the back, four around the ventral surface, and three below the lateral line; in addition, there are many scattered dark flecks which coalesce to form irregular markings on the body and head. Dorsal, anal and caudal fins with oblique, greyish-brown bars tending to form angular markings; the filamentous anterior dorsal rays are white. Pectoral with a black ocellus on its distal portion, and irregular greyish-brown crossbands. Ventral rays with brown bars, which are most pronounced on their terminal expansions. According to Ogilby, the general colour was lavender when the fish was fresh.

Described and figured from the unique holotype of the species, 171 mm. long.

Our description differs in several details, such as fin-counts and proportions, from that prepared by Ogilby on board the "Endeavour," but we have checked the discrepancies by reference to the holotype. Ogilby's work upon the ship was carried out under great difficulty, which doubtless accounts for numerous inaccuracies occurring in his various descriptions prepared at that time, and which were later published without further examination of the specimens described.

Affinities.—This species has no resemblance to the genus *Arnoglossus*, in which it was placed by Ogilby, but is referable to *Samaris*. It is very similar to both *S. cristatus* Gray, from Chinese and Indian seas, and *S. ornatus* Bonde, from Natal, but is best maintained as a distinct species until its true status can be determined by a comparison with specimens from those localities.

Locality.—20 miles N.E. of Gloucester Head, Queensland, 35 fathoms. The locality given by Ogilby as 21 miles S. 62° W. from Capt. Gloucester, 26 fathoms, is obviously incorrect, that position being upon the land.

Family CYNOGLOSSIDAE.

RHINOPLAGUSIA JAPONICA *Schlegel.*

(Figure 3.)

Plagusia japonica Schlegel, Fauna Japonica, Pisces, 1846, p. 187, pl. xcv, fig. 2. *Id.* Gunther, Brit. Mus. Cat. Fish. iv, 1862, p. 492. *Id.* Klunzinger, Sitzb. Akad. Wiss. Wien lxxx.i. 1879, p. 409.

Usinosita japonica Jordan & Starks, Proc. U.S. Nat. Mus. xxxi, 1906, p. 236 (Synonymy and references).

Plagusia guttata Macleay, Proc. Linn. Soc. N.S.Wales ii, 1878, p. 362, pl. x, fig. 3, and *Op. cit.* vi, 1881, p. 137.

Plagusia notata De Vis, Proc. Linn. Soc. N.S.Wales viii. 2, 1883, p. 288. *Id.* Kent, Proc. Roy. Soc. Qld. vi, 1889, p. 240.

D.107; A.84; V.4; C.8. Lateral line, from its junction with the lines on the head to the hypural joint, 96.

Total length, including the rostral membrane, 100 mm. Breadth of the body at the origin of the anal fin, and exclusive of membranes covering the bases of the dorsal and anal fins (25 mm.), 3.7 in the length to the base of the tail (94.5). Head (24) a trifle less than the breadth of the body, and 3.9 in the length.

Eyes small, the upper considerably in advance of the lower, and separated by a flat scaly interspace of which the width is a little less than the diameter of the eye; lower eye separated from the mouth only by a narrow bony ridge, its anterior margin below the hinder third of the upper eye. Head entirely scaly. Lips with very small dermal tentacles and lones on the upper side; lips of lower side without them. Posterior angle of the mouth-opening a little behind the middle of the lower eye; the mouth is almost straight on the upper side, and without teeth, but on the lower it is considerably arched and there is a band of villiform teeth on each jaw, those of the mandible largest. Rostral hook extending backward a little beyond the vertical of the angle of the mouth; it has a membranous border, which is as wide as the eye anteriorly, but tapers to the end of the rostral hook below, and merges into a membrane which covers the base of the dorsal fin on the upper side. A short tube close to the edge of the mouth and a little in advance of the lower eye is the opening of the only nostril on the upper side; a larger tube is in a corresponding position on the lower side, and is followed by the simple opening of the posterior nostril.

Entire upper surface covered with ctenoid scales, which extend onto the membranous border of the rostral hook and on that covering the bases of the dorsal and anal fins on the upper side; the scales on the lower surface of the head are cycloid anteriorly, but they develop microscopic teeth at their tips in increasing numbers as they extend backwards, though the denticles are never so numerous on the lower as on the upper side. Three lateral lines are present on the upper surface; one near the dorsal line, another near the ventral, and the third along the middle of the side, all reaching the base of the tail. The lower surface of the body is without lateral lines. Upper surface of head with a complex system arranged as shown in the accompanying figure, but on the lower side a few rudimentary lines may be present or absent.

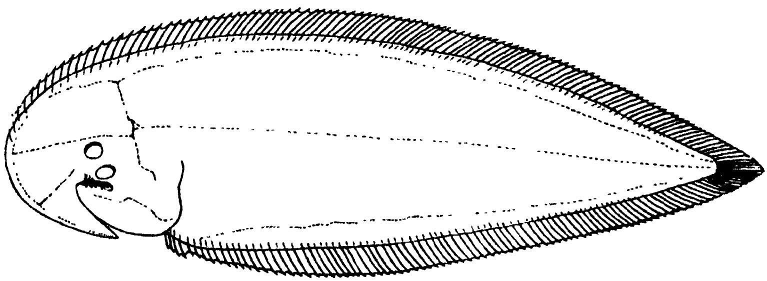


Figure 3.
Rhinoplagusia japonica Schlegel. Lectotype of *Plagusia guttata* Macleay, 100 mm. long, from Port Darwin, north Australia.

First dorsal ray arising in the rostral membrane at about the same level as the upper edge of the upper eye; the rays are simple, longest above the middle of the body, and a little more than one-fourth as long as the head. Anal rays similar to those of the dorsal opposite them; dorsal and anal united with the caudal. No pectoral fins. Only one ventral fin, which is on the ridge of the abdomen; its fourth ray is longest, 5.0 in the head, and united with the first anal ray by membrane. Vent near the base of the first anal ray, but on the lower surface. Caudal rays simple, 4.3 in the head.

Colour.—The specimen described above, which is a co-type, is completely faded and all traces of colour-marking have disappeared. A smaller co-type exhibits a number of light coloured spots on the head and body, some of which are larger than the eye. Three small specimens collected by the senior author at Cooktown, north Queensland, are light greyish-brown all over, and mottled with light rounded spots plentifully disposed over the head and body; the fins are speckled with greyish-brown streaks upon the rays.

Described and figured from one of the co-types, 100 mm. long, and preserved in the Macleay Museum, from Port Darwin.

Lectotype.—It might be considered that the choice of a lectotype for redescription and figuring should fall upon a co-type of the same size as the original figure, which is said to be of natural size. One specimen, 82 mm. long, almost exactly equals the length of the figure, but it is not so well preserved as the larger one, which we have chosen.

Variation.—Ten specimens, 72-196 mm. long, exhibit but little variation. Their fin- and scale-counts are as follow:—D.107-8, A.84, V.4, C.8; 90-96 scales on the lateral line between its junction with the transverse line above the operculum and the hypural joint.

Synonymy.—The identity of *R. guttata* Macleay and *R. japonica* Schlegel was recognised by Klunzinger in 1879. We have examined the five co-types of *guttata* from Port Darwin, which are preserved in the Macleay Museum, and several larger ones in the Australian Museum from Port Darwin and Moreton Bay. We have compared these with Jordan and Starks' description of *japonica*, and find that it applies to our specimens so well that we follow Klunzinger in uniting *guttata* with *japonica*.

The type of *Plagusia notata* De Vis was obtained in Moreton Bay, and we are fortunate in having a specimen, 196 mm. long, in the Australian Museum collection from the same locality. It agrees well with De Vis' brief description in all essential details, and it is evidently referable to his species. A critical comparison of this specimen with our largest Port Darwin representative of *guttata* fails to reveal any specific differences between them, so we are led to the conclusion that *notata* De Vis is synonymous with *guttata* Macleay, and that both are synonymous with *japónica* Schlegel.

Localities.—Port Darwin, Northern Territory; co-types of *Plagusia guttata*; Macleay Museum collection.

Port Darwin; coll. Christie & Godfrey, 1902; Aust. Mus. coll.

Endeavour River, Cooktown (Macleay Museum).

Finche's Bay, Cooktown, Queensland; coll. A. R. McCulloch, June, 1918; Aust. Mus. coll.

Moreton Bay, Queensland; Australian Museum collection.

PARAPLAGUSIA UNICOLOR *Macleay.*

(Figure 4.)

Plagusia unicolor Macleay, Proc. Linn. Soc. N.S.Wales vi. 1, 1881, p. 138, and vii, 1882, p. 13. *Id.* Ogilby, Ed. Fish. N.S.Wales, 1893, p. 163.

Symphurus unicolor Waite, Mem. N.S.Wales Nat. Club ii, 1904, p. 44. *Id.* Stead, Ed. Fish. N.S.Wales, 1908, p. 107, pl. lxxiv.

Paraplagusia unicolor McCulloch, Austr. Zoologist ii.2, 1921, p. 37. *Id.* Lord, Proc. Roy. Soc. Tasm. 1922 (1923), p. 66.

D.113; A.87; V.4; C.8. Median lateral line, from its junction with the other branches above the operculum to the hypural joint, 96.

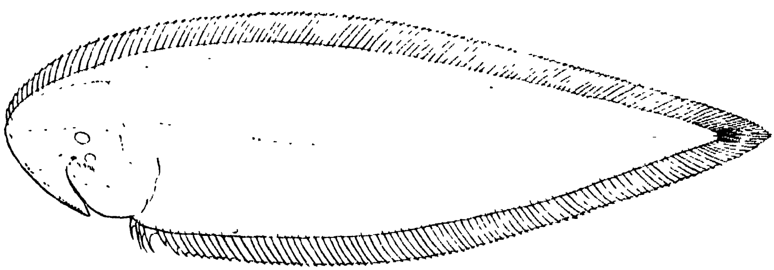


Figure 4.
Paraplagusia unicolor Macl. Co type, 129 mm. long, from Port Jackson, New South Wales.

Total length, 129 mm. Breadth of the body at about the middle of its length (31 mm.) 3.8 in the length to the hypural (119); head (27) 4.4 in the same. Eye (2.25) a little greater than the breadth of the interocular space (1.5). Snout from the level of the anterior angle of the mouth to the tip (11) 2.4 in the head.

Eyes small, the upper in advance of the lower by about two-thirds of its length; interorbital space sealy, lower eye separated from the mouth by a narrow bony ridge. Lips of the upper side with a row of conspicuous fringes; no fringes on the under side. Posterior angle of the mouth below the hinder margin of the lower eye; mouth almost straight above and without teeth, but on the lower side it is considerably arched, and there is a band of villiform teeth in each jaw. Rostral hook extending backward to a vertical a little in advance of the posterior angle of the mouth. Nostril of the upper side in a short tube, and situated near the mouth a little in advance of the lower eye; lower anterior nostril in a tube placed a little in advance of the mouth, the posterior a simple opening.

The whole surface of the head and body is covered with strongly ctenoid scales, which extend onto the membranous border of the rostral hook and on that covering the bases of the dorsal and anal fins on the upper side; the median caudal rays also are scaly, but the rest of the fins are naked. Most of the scales on the lower side are also ctenoid, only a few on the anterior part of the head being cycloid. Upper side of the body with two lateral lines, one near the dorsal edge and the other along the middle of the side; a complex system of lines on the upper surface of the head; lower side without lateral lines.

First dorsal ray arising at the extreme tip of the snout; the rays are simple, longest above the middle of the body, and about one-fourth as long as the head. Anal rays similar to those of the dorsal opposite them; dorsal and anal united with the caudal. No pectoral fins. Only one ventral fin which is on the ridge of the abdomen, the fourth ventral ray is longest, 4.5 in the head. Vent near the base of the first anal ray on the lower surface. Caudal rays simple.

Colour.—According to Macleay, the colour is light yellowish-brown, indistinctly mottled with ashy-grey; the specimen is now completely bleached.

Described and figured from one of the co-types, 129 mm. long, and preserved in the Macleay Museum, from Port Jackson.

The bottle of type specimens in the Macleay Museum contains five specimens, 129-286 mm. in length. The specimen from which the original description was made was said to be six inches long, but none of these are quite that length. Two are 158-164 mm. long, but are rather badly preserved, so we have redescribed and figured the smallest of the series, which is in good condition and does not offer any marked variation from the larger specimens.

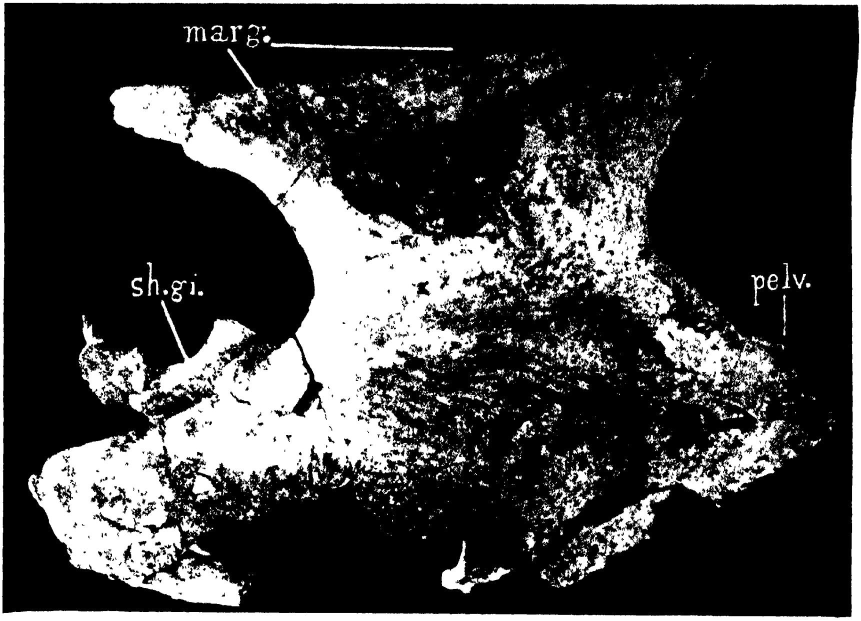
Locality.—Port Jackson. According to Ogilby (1893), this species has been recognised from Lord Howe Island and from Queensland, but both these records are unreliable. Lord's (1923) record of its occurrence on the north-east coast of Tasmania is equally unsatisfactory.

EXPLANATION OF PLATE XXX.

Fig. 1. *Meiolania platyceps* Owen. Plastron, ventral view. A.M. No. F. 1208; x 1/6 about.

„ 2. Plastron, dorsal view.

Co. coracoid; *gl. foss.* glenoid fossa; *il,* ilium; *is.*, ischium; *marg.*, marginal plates; *p.*, pubis; *pb. is. f.*, pubo-ischiadic foramen; *pelv.*, pelvis; *p.pr.*, pectineal process; *sc.,* scapula; *sh.gi.*, shoulder girdle; *vert.,* vertebrae.



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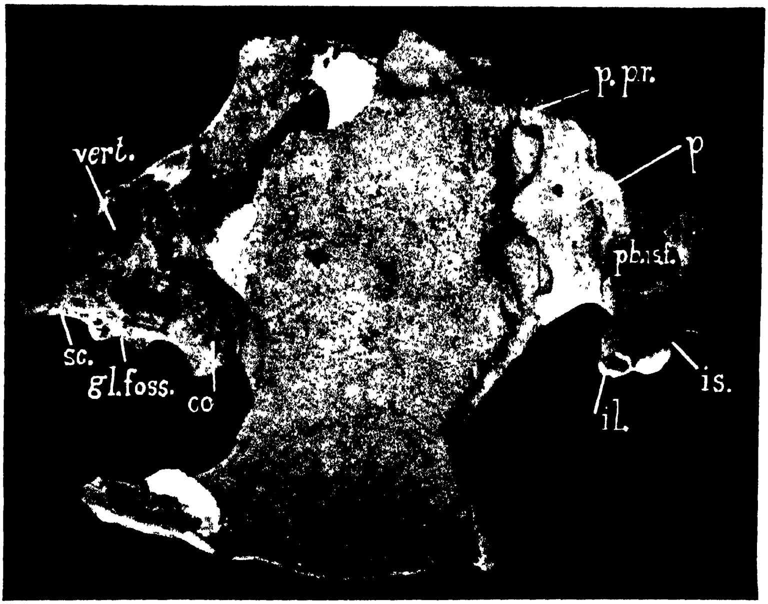

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G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXXI.

Fig. 1. *Meiolania platyceps* Owen. Front portion of skull. A.M. No. F. 398; x $\frac{3}{4}$ about.

„ 2. Same specimen, palatal view.

f.inc., foramen incisivum; *orb.*, orbit; *temp.foss.*, temporal fossa.

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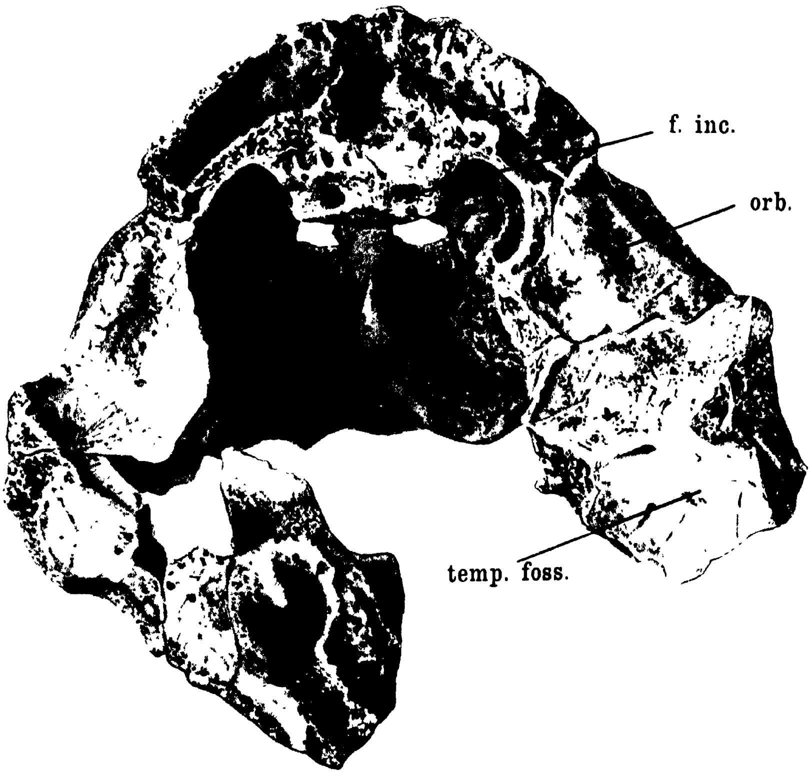

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PHYLLIS F. CLARKE, del.

EXPLANATION OF PLATE XXXII.

Fig. 1. *Meiolania platyceps* Owen. Part left side of skull roof (upside down). A.M. Nos. F.5473, 1197.

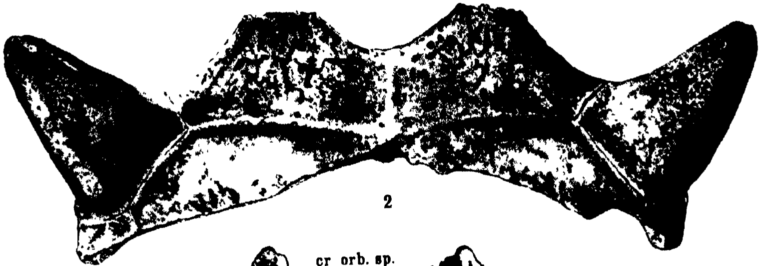
,, 2. *Meiolania platyceps*. Posterior part of skull roof from behind. Mines Department collection.

,, 3, 4. *Meiolania platyceps*. Left cranial horn core, side and inferior views; A.M. No. F.16866.

,, 5, 6. *Meiolania mackayi*, sp. nov. Left cranial horn core, side and inferior views; A.M., No. F17720, holotype.

Cr.orb. sp., crista orbito-sphenoidea; *mx.p.*, maxillary pocket: *sulc.olf.*, sulcus olfactorius; *temp.foss.*, temporal fossa; *ty. foss.*, tympanic fossa.

All figures slightly larger than half natural size.



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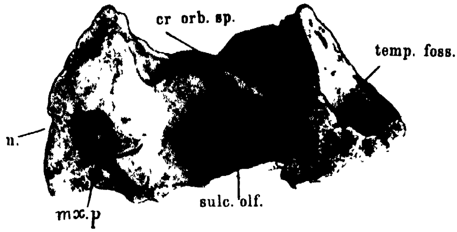

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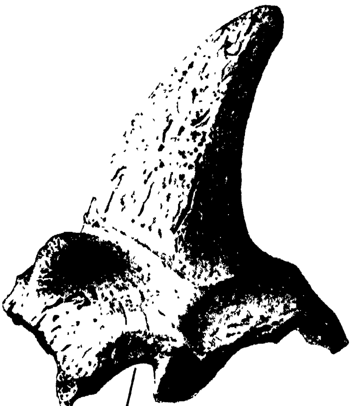

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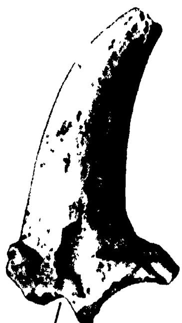

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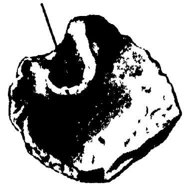

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PHYLLIS CLARKE (3, 4), del.
HELEN E. BAILEY (1, 2, 5, 6), del.

EXPLANATION OF PLATE XXXIII.

Fig. 1. *Meiolania platyceps* Owen. Part occipital region. A.M., No. F.18363; x ½ about.

„ 2. Basicranial region from below. A.M., No. F.1209; less than half natural size.

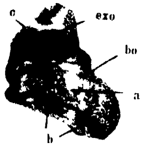
„ 3. Front view of brain case. A.M., No. F.1209; less than half natural size.

„ 4. Tympanic region, left side, front to left. A.M., No. F.1209; x ½ about.

„ 5. Brain cavity from above. A.M., No. F.208b; less than half natural size.

„ 6. Brain cavity from above. A.M., No. F.208a; more than half natural size.

a, basisphenoid facies of basioccipital; *b*, pterygoid facies of basioccipital; *c*, position of foramen jugulare (vago-accessory canal); *d*, intra-pterygoid slit; *e*, descending parietal plate (?); *f*, opening for passage of columella auris; *g*, canal tunnelling floor of brain case; *h*, opening into auditory chamber; *abd.c.*, abducent canal; *bo*, basioccipital; *bs*, basisphenoid; *c.cav.*, canalis cavernosus; *car.c.*, carotid canal; *car.temp.c.*, carotico-temporal canal; *c.com.*, canal commissure; *c.s.ant.*, anterior semicircular canal; *c.s.post*, posterior semicircular canal; *cl.pr.*, clinoid process; *cond.*, occipital condyle; *e.xo.*, exoccipital; *f.jug.ant.*, foramen jugulare anterius (vago-accessory foramen); *fen.pst.*, fenestra postotica; *hyp.c.*, hypoglossal canal; *int.aud.mc.*, internal auditory meatus; *pt.*, pterygoid.



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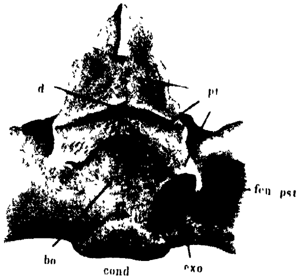

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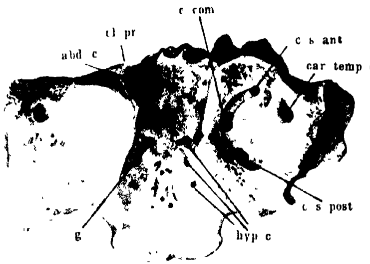

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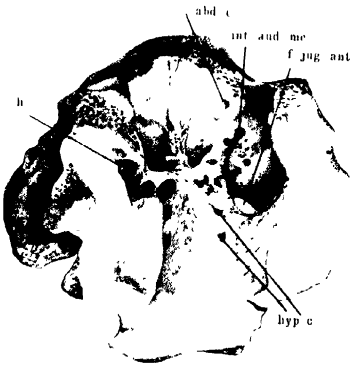

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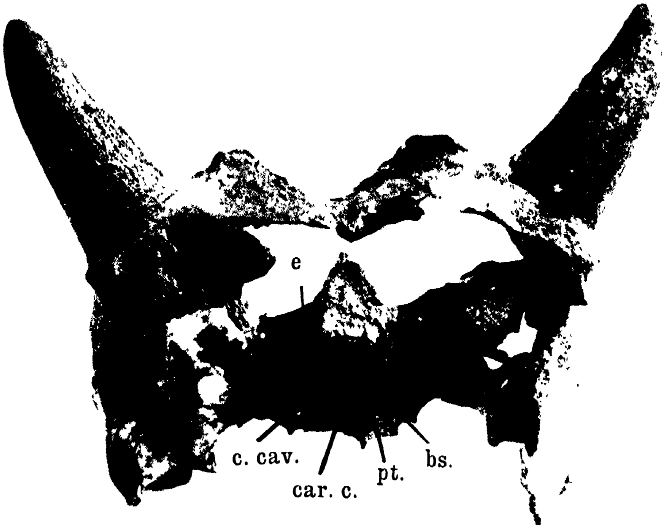
4

HELEN E. BAILEY (4), del.
A. R. MCCULLOCH (3, 5, 6), del.
G. P. WHITLEY (1, 2), del.

EXPLANATION OF PLATE XXXIV.

Fig. 1. *Meiolania platyceps* Owen. Front view posterior portion of skull. A.M., No. F.1209; x ½ about.

„ 2. Same specimen from right side; x ¾ about.
e, descending parietal plate (?); *bs.*, basisphenoid; *c.cav.*, canalis cavernosus; *car.c.*, carotid canal; *pt.*, pterygoid.



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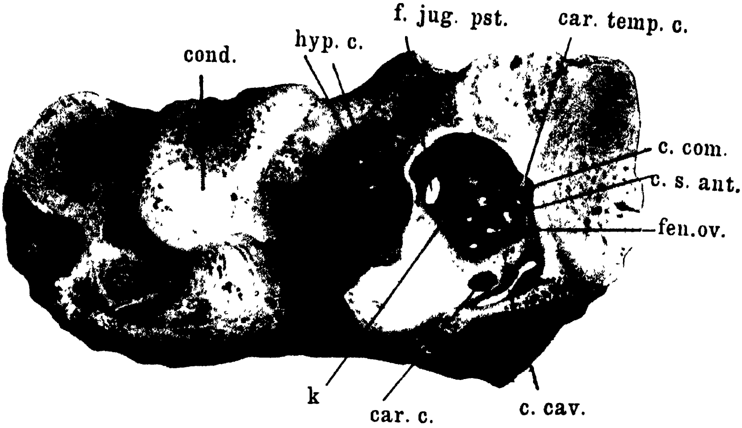
G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXXV.

Fig. 1. *Meiolania platyceps* Owen. Looking into fenestra postocia. A.M., No. F.208b; slightly enlarged.

„ 2. Same specimen showing auditory chamber from medial direction; x 4/3 about.

g, canal tunnelling floor of brain case; *k*, opening from vago-accessory canal into auditory chamber; *l*, medial wall of exterior semicircular canal; *m*. opisthotic vestibular recess; *abd.c.*, abducent canal; *c.cav.*, canalis cavernosus; *c.com.*, canal commissure; *car.c.*, carotid canal; *car. temp.c.*, carotico-temporal canal; *c.s.ant.*, anterior semicircular canal; *c.s.ext.*, exterior (horizontal) semicircular canal; *c.s.post.*, posterior semicircular canal; *cl.pr.*, clinoid process; *cond.*, occipital condyle; *f.jug.ant.*, foramen jugulare anterius; *f.jug.post.*, foramen jugulare, posterior view: *fen.ov.*, fenestra ovalis; *hyp.c.*, hypoglossal canal.



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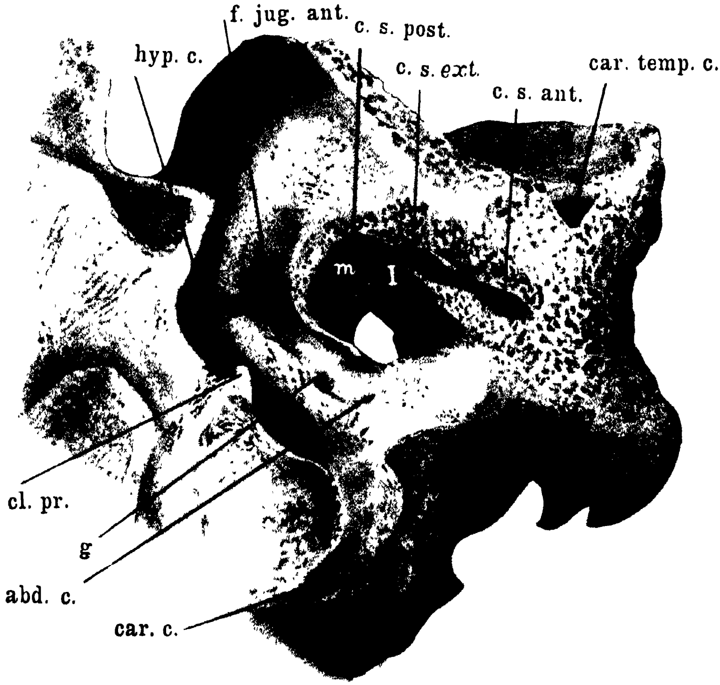

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G. P. WHITLEY, del.

EXPLANATION OF PLATE XXXVI.

Meiolania platyceps Owen. Model of skull prepared by J. Kingsley, Australian Museum, reproduced about one-fifth natural size.

Fig. 1. Front view.

„ 2. Side view.

„ 3. Top view.

„ 4. Back view.

„ 5. Sagittal section.

„ 6. Palatal view.

The plate descending from prefrontal to palatal region is more or less conjectural.

d, intrapterygoid slit; *e*, descending parietal plate (?); *f*, opening for passage of columella auris; *g*, canal tunnelling floor of brain case; *n*, external nostril; *abd.c.*, abducent canal; *ch.*, choana; *cr.orb.sp.*, crista orbito-sphenoidea; *fen. pst.*, fenestra postotica; *f.jug.ant.*, foramen jugulare anterius; *hyp.c.*, hypoglossal canal; *int.aud.me.*, internal auditory meatus; *m.r.p.*, maxillary pocket; *pst.pal.f.*, posterior palatine foramen; *st.fi.*, stapedial fissure; *sulc.olf.*, sulcus olfactorius.

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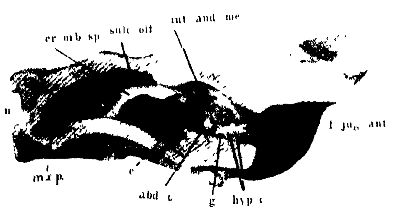

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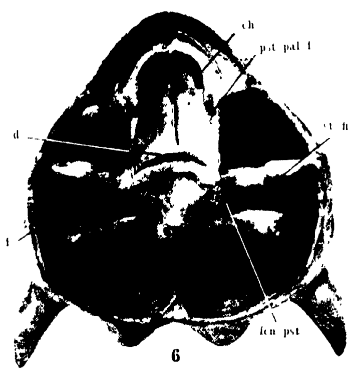

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G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXXVII.

Fig. 1. *Meiolania platyceps* Owen. Cervical vertebrae. A.M., No. F.18315; less than half natural size.

„ 2. Two late cervicals, perhaps seventh and eighth. A.M., Nos. F.18494, 18495; x ½ about.

„ 3. Late cervical (eighth ?), front view. A.M., No. F.18495; slightly larger than half natural size.

„ 4. Sacral vertebrae; A.M., No. F.9067 from below; less than half natural size.

„ 5. Same specimen from side and above; larger than half natural size.

di., diapophysis; *par.*, parapophysis.

1

2 3

4 5

G. C. CLUTTON, photo.

EXPLANATION OF PLATE XXXVIII.

Fig. 1. *Meiolania platyceps* Owen. Left shoulder girdle; A.M., No. F.18496.

„ 2. *Meiolania platyceps* Owen. Left humerus, ventral view; A.M., No. F.1204.

„ 3. *Meiolania platyceps* Owen. Same specimen from ulnar side.

„ 4. *Meiolania platyceps* Owen. Right humerus, distal end, ventral view. A.M., No. F.405.

„ 5. *Meiolania platyceps* Owen. Same specimen, distal end, dorsal view.

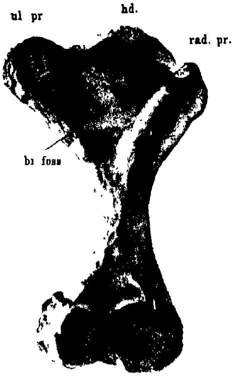
„ 6. *Meiolania mackayi*, sp. nov. Left humerus, proximal end, ventral view; A.M., No. 17719.

„ 7. *Meiolania mackayi*. Right humerus, distal end, ventral view, A.M., No. F.17657.

„ 8. *Meiolania mackayi*. Same specimen, distal end, dorsal view.

bi.foss., bicipital fossa; *co.*, coracoid; *ect.cond.*, ectocondyle; *ecte.cond.*, ectepicondyle; *ecte.f.*, ectepicondylar foramen; *ent.cond.*, entocondyle; *ente.cond.*, entepicondyle; *hd.*, head; *pr.co.*, procoracoid; *rad.pr.*, radial process; *sc.*, scapula; *ul.pr.*, ulnar process.

All figures less than half natural size.



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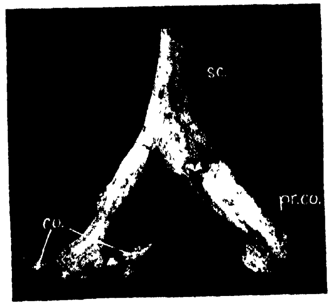

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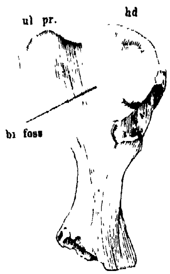

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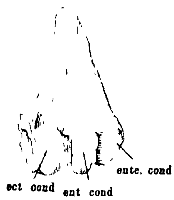

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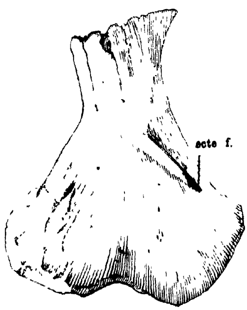

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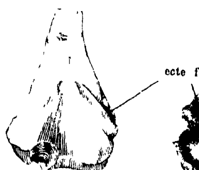

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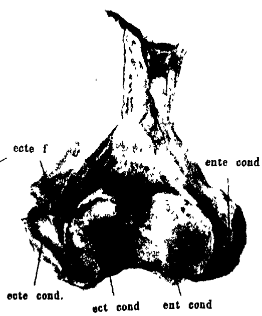


4

HELEN E. BAILEY (2-8), del.
G. C. CLUTTON (1), photo.

EXPLANATION OF PLATE XXXIX.

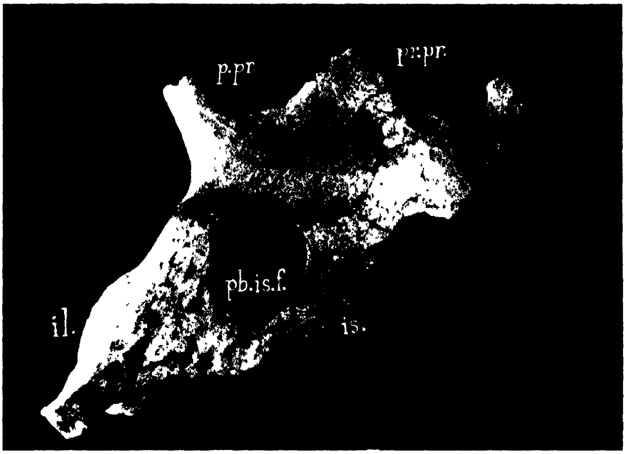
Meiolania platyceps Owen.

Fig. 1. Pelvis. A.M., No. F.18497, dorsal view: less than half natural size.

,, 2. Same, ventral view.

,, 3. Same, from left side.

ac., acetabulum: *il.*, ilium: *is.*, ischium; *pub.is.f.*, pubo-ischiadic foramen; *p.pr.*, pectineal process of pubis; *pr.pr.*, prepubic process.



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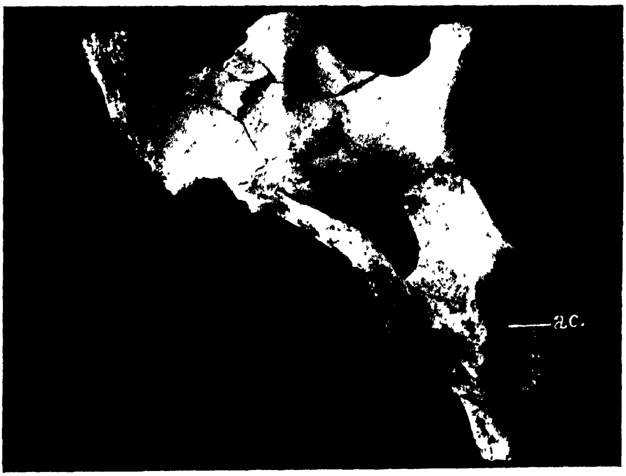

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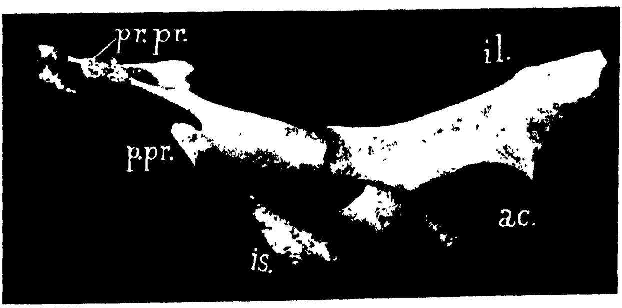

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G. C. CLUTTON, photo.

EXPLANATION OF PLATE XL.

Fig. 1. *Meiolania platyceps* Owen. Right femur; A.M., Nos. F.1203, 16858; x ½ about.

„ 2. *Meiolania platyceps* Owen. Left femur from fibular side; Mines Department collection; less than half natural size.

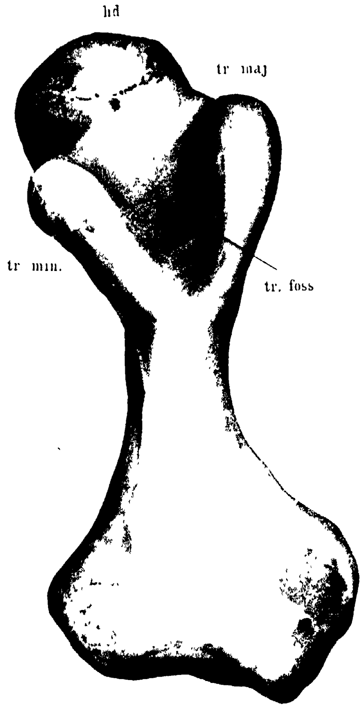
„ 3. *Meiolania mackayi* sp. nov. Right femur, proximal end, A.M., No. F.17665; slightly less than half natural size.

„ 4. *Meiolania mackayi* sp. nov. Right tibia; A.M., No. F.17660; slightly less than half natural size.

„ 5. *Meiolania platyceps*. Egg mould, A.M., No. F.1049; slightly less than half natural size.

hd., head; *tr.foss.*, intertrochanteric fossa; *tr.major,* trochanter major; *tr.min.*, trochanter minor.

2



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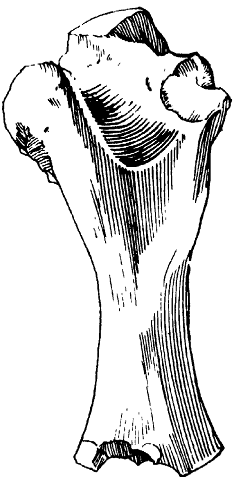

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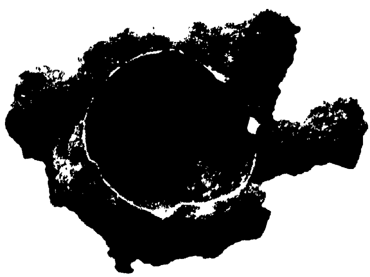

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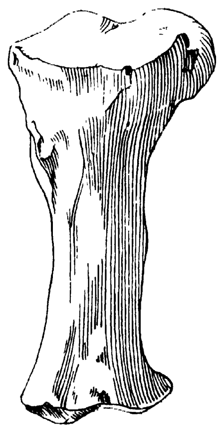


4

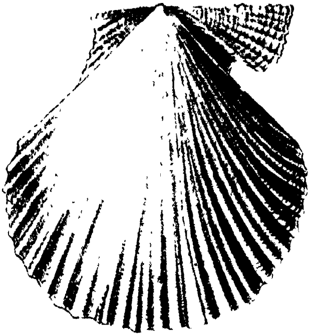
HELEN E. BAILEY (3, 4), del.
A. R. McCULLOCH (1), del.

EXPLANATION OF PLATE XLI.

Fig. 1, 2. *Chlamys famigerator* Iredale, type, right and left valve.

„ 3, 4. *Chlamys perillustris* Iredale, type, left and right valve.

„ 5, 6, 7. *Chlamys instar* Iredale, type, left valve adult, sculpture of adult, right valve juvenile.



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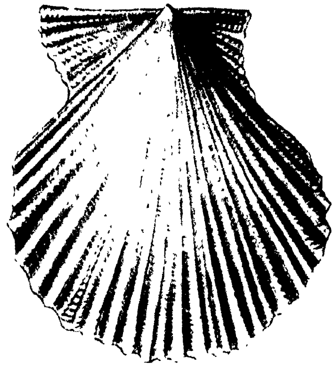

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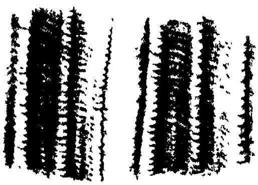

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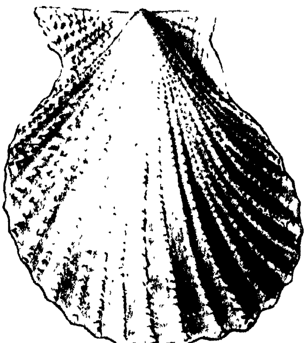

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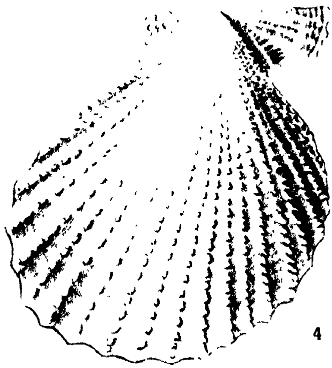

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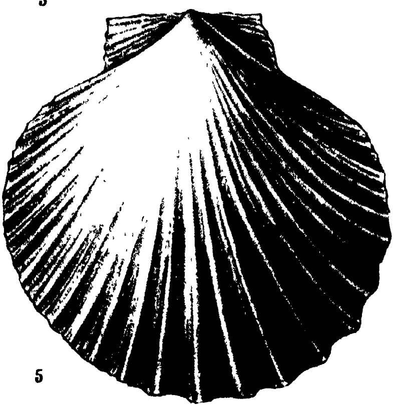

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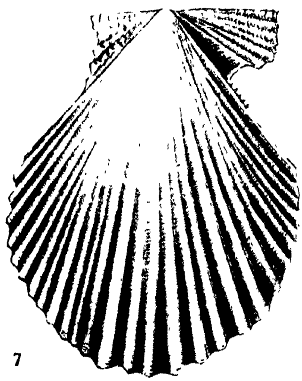

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JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XLII.

Fig. 8. *Venericardia (excelsior) semota* Iredale, type.

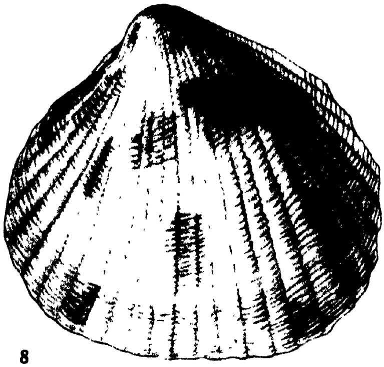
,, 9. *Nuculana oculata* Iredale, type.

,, 10, 11. *Emarginula curvamen* Iredale, type.

,, 12, 13. *Emarginula amitina* Iredale, type.

,, 14. *Scaphander illecebrosus* Iredale, type.

,, 15. *Obrussa bracteata* Iredale, type.



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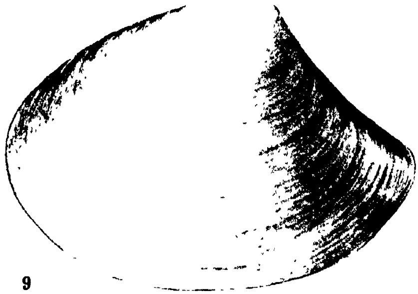

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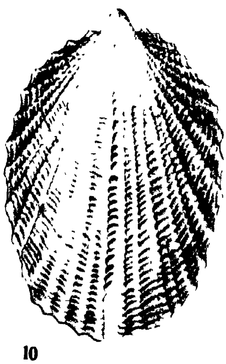

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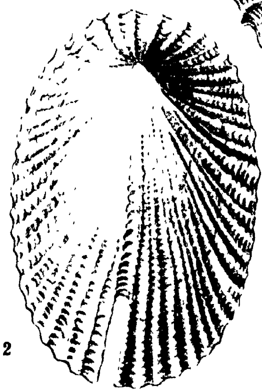

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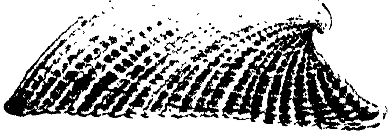

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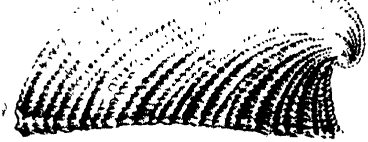


11

JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XLIII.

Fig. 16. *Microsveltia recessa* Iredale, type.

„ 17. *Ctenocolpus australis diffidens* Iredale, type.

„ 18. *Trigonostoma vinnulum* Iredale, type.

„ 19. *Fax tabida* Hedley.

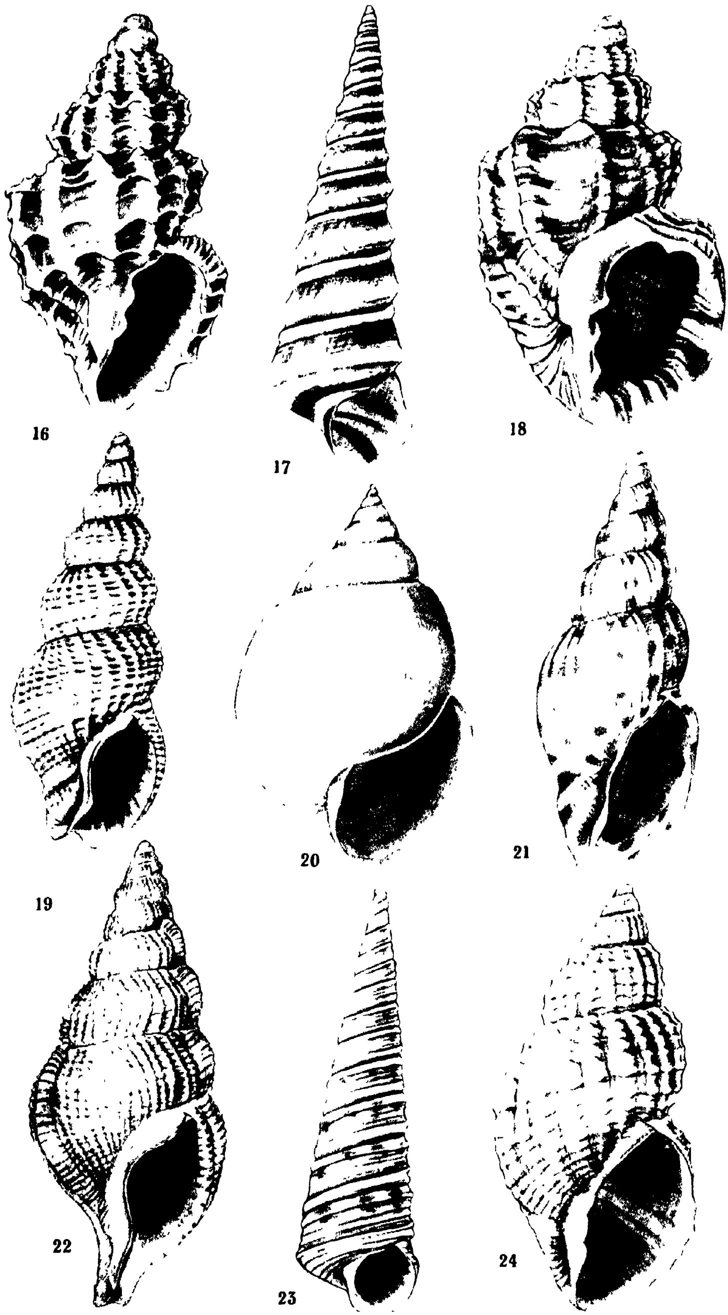
„ 20. *Stilapex lactarius* Iredale, type.

„ 21. *Fax (tenuicostata) conspicienda* Iredale, type.

„ 22. *Obex mulveyana* Iredale, type.

„ 23. *Turritella sophiae* Brazier, type (=*sinuata* Reeve).

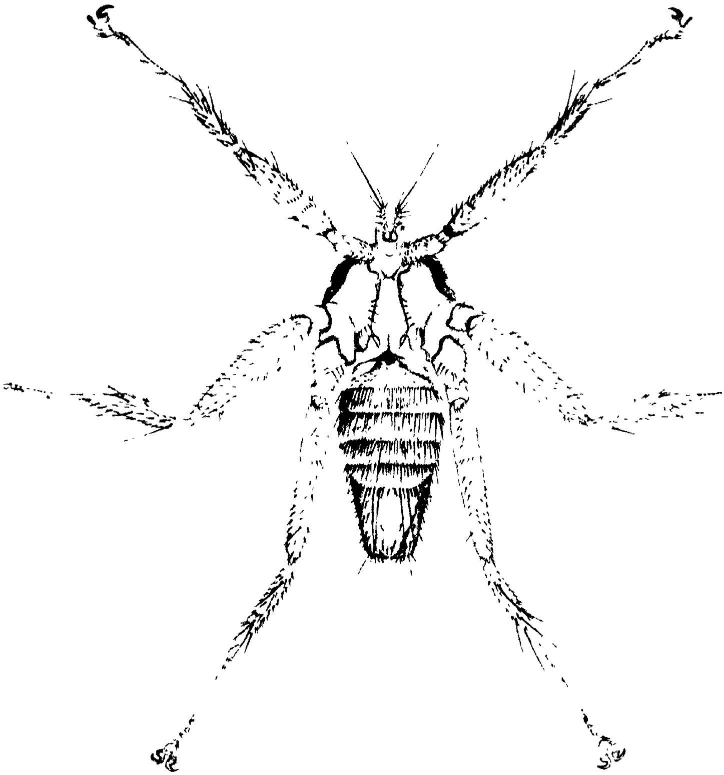
„ 24. *Cancellaria purpuriformis anxifer* Iredale, type.



JOYCE K. ALLAN, del.

EXPLANATION OF PLATE XLIV.

Nycteribia (Nycteribia) falcozi sp. nov. Male holotype. Dorsal view.



A. MUSGRAVE, del.

EXPANATION OF PLATE XLV.

Nycteribia (*Nycteribia*) *brevicauda* sp. nov.

Fig. 1, 2. Male holotype, dorsal and ventral views of abdomen.

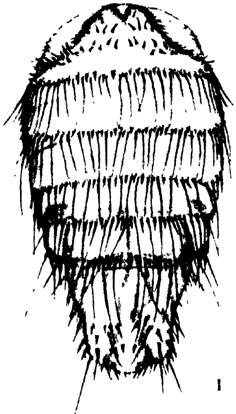
„ 3, 4. Female allotype, dorsal and ventral views of abdomen.

Nycteribia (*Nycteribia*) *falcozi* sp nov.

Fig. 5. Male holotype, ventral view of thorax and abdomen.

„ 6. Female allotype, dorsal view of abdomen.

„ 7. Female allotype, ventral view of thorax and abdomen.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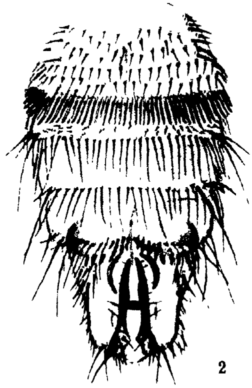
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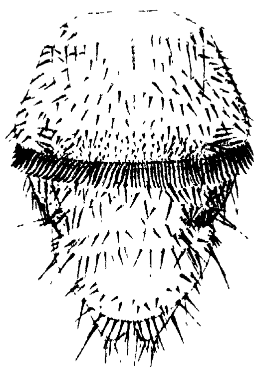
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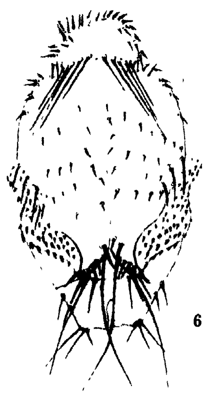
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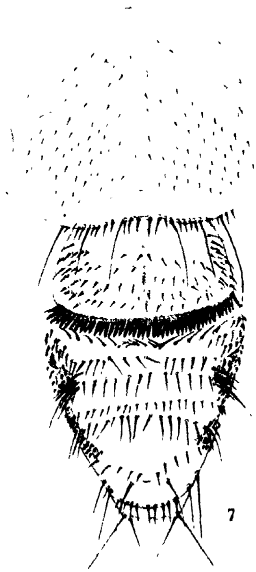
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JOYCE K. ALLAN (1-4), del.
A. MUSGRAVE (5-7), del.

EXPLANATION OF PLATE XLVI.

Fig. 1. Zooecial detail of *C. crassa* looking down onto the colony from the apex. The top of the drawing runs up to the apex and is considered as distal; the bottom of the drawing represents the edges of the conical zoarium, and is considered proximal.

Fig. 2. Part of the zoarium of *C. crassa* showing the structure and detail of the anchoring filament.

Fig. 3. Portion of the zoarium of *C. crassa* tilted on edge until the true zooecial aperture can be seen below the peristomial aperture. Drawn from zooecia on the edge of the colony, the top of the drawing being distal (towards apex) and the bottom proximal (edge of colony).

Fig. 4. An avicularium of *C. crassa* showing the central cross-bar and the attached ligula.

Fig. 5. An enlarged view of a filament cell showing two communication pores in the basal wall.

Drawings made from a specimen from 16-18 miles N.E. of Port Jackson, New South Wales, 75-80 fathoms.

G. P. WHITLEY, del.

EXPLANATION OF PLATE XLVII.

Fig. 1. *Saccolaimus flaviventris* Peters. Male. Moree, N.S.W. Showing secondary gular sac.

„ 2. „ *nudicluniatis* De Vis. Cotype, female.

„ 3. „ *mixtus sp. nov.* Type, male.

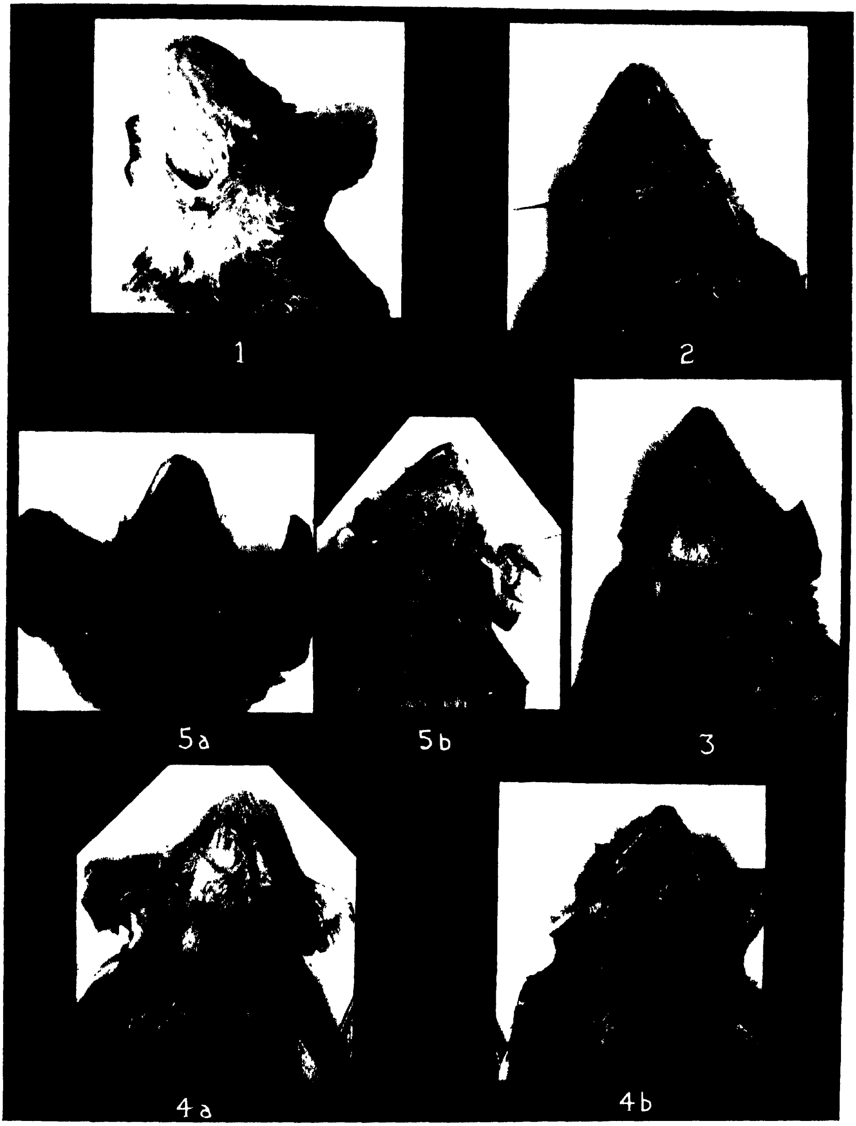
„ 4. a. *Taphozous australis* Gould. Male, showing definite gular sac.

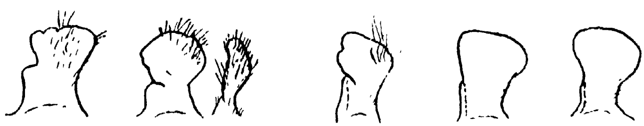
b. „ „ Gould. Female, showing rudiments of sac.

„ 5. a. „ *georgianus* Thomas. Male. } Showing absence of gular sac or its rudiments.

b. „ „ „ Female. } Showing absence of gular sac or its rudiments.

e. Tragus.





G. C. CLUTTON, photo.

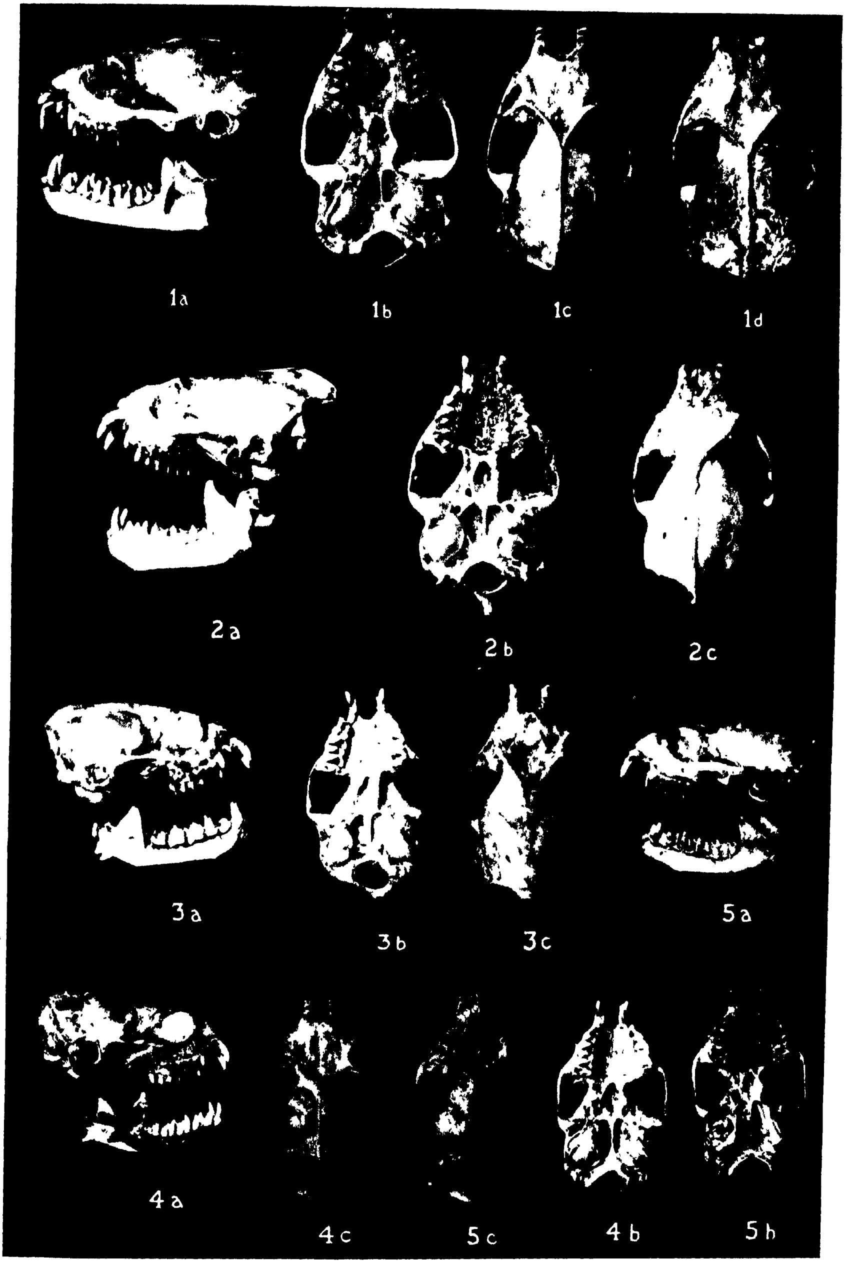
EXPLANATION OF PLATE XLVIII.

Fig.	1.	*Saccolaimus flaviventris* Peters.	Male, Moree, N.S. Wales.
„	1d.	„ „ „	Type skull, upper view.
„	2.	„ *nudicluniatus* De Vis.	Cotype, female.
„	3.	„ *mixtus sp. nov.*	Type, male.
„	4.	*Taphozous australis* Gould.	Male.
„	5.	„ *georgianus* Thomas.	Female.

a. Side view of skull and mandible.

b. Under surface of skull.

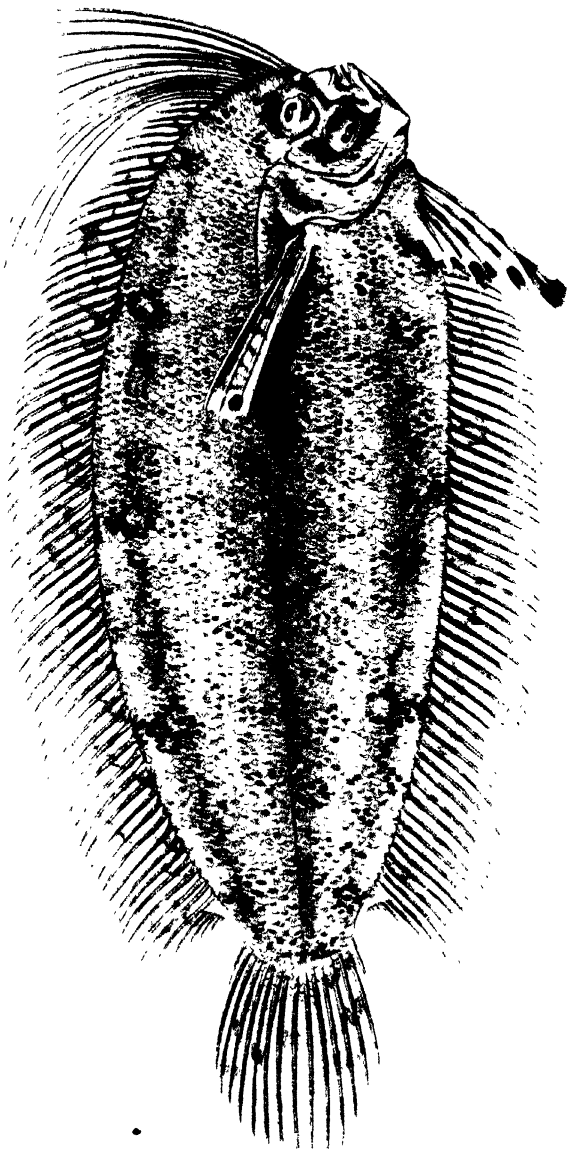
c. Upper surface of skull.



G. C. Clutton, photo.

EXPLANATION OF PLATE XLIX.

Samaris cacatuae Ogilby. Holotype of *Arnoglossus cacatuae*, 171 mm. long, from N.E. of Gloucester Head.



A. R. McCulloch, del.

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